Engineering Library

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The Engineer.

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VOL. CXLIX.—No. 3862] LONDON: FRIDAY EVENING, JANUARY 17, 1930 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department, Belvedere-road, Lambeth, London, S.E. 1, invites TENDERS for :—

SCHEDULE 1.—TWO SALOON UNDER-FRAMES and BOGIES, metre gauge.
SCHEDULE 2.—4243 TONS of 50 lb. STEEL RAILS, with 127 TONS of FISHPLATES.
SCHEDULE 3.—SWITCHES and CROSSINGS.
SCHEDULE 4.—SIXTEEN LOCOMOTIVES, Z.E. Type, for 2ft. 6in. gauge.
SCHEDULE 5.—18,000 STEEL BOILER TUBES for LOCOMOTIVES.

Tenders due as follows :—
Schedule 1, 31st January, 1930.
Schedules 2 and 3, 4th February, 1930.
Schedule 4, 7th February, 1930.
Schedule 5, 19th February, 1930.

Forms of Tender available from the above at a fee (which will not be returned) of 5s. for each Schedule 42 27

Air Ministry. DIRECTORATE OF TECHNICAL DEVELOPMENT.

The following DRAUGHTSMEN are REQUIRED at the Royal Aircraft Establishment :—

REFERENCE No. A. 392.—ONE DRAUGHTSMAN, Grade II., for work in connection with aircraft. Salary £125 plus Civil Service bonus per annum, giving a present total starting remuneration of £199 16s. per annum, on the basic scale £125-£7 10s.-£150 plus bonus.

REFERENCE Nos. A. 373-390 AND 403.—THREE DRAUGHTSMEN, Grade III., one (A. 373) for work on plant and ground equipment, requiring general experience in mechanical and structural work, and preferably some surveying experience. One (A. 390) for detail work in the design of wireless apparatus. One (A. 403) for detail work in the design of small mechanical apparatus, such as indicating and recording instruments.

Salary 40s. to 52s. plus Civil Service bonus per week, depending on experience; present equivalent of 40s. to 52s. plus bonus is £3 6s. 3d. to £4 2s.

Candidates should have had good technical training and experience appropriate to the position for which application is made. Preference given, other things being equal, to ex-Service men.

Write (quoting appropriate reference number), stating age and full particulars of training and experience, to the CHIEF SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough, Hants. 4177

Crown Agents for the COLONIES. COLONIAL GOVERNMENT APPOINTMENTS.

APPLICATIONS from qualified candidates are INVITED for the following POST :—

M/1285.—ENGINEERING ASSISTANT REQUIRED by the GOVERNMENT of NIGERIA for service in the Harbour Department for two tours, each of 12 to 18 months' service, and the prospect after three years satisfactory service of the selected candidate being eligible for transfer to the permanent and pensionable establishment. Salary £510, rising to £720 a year by annual increments of £30, and thence rising to £800 a year by annual increments of £40. Free quarters and passages and liberal leave on full salary. Outfit allowance of £60 on first appointment. Candidates, 25 to 35 years of age, must be well versed in the principles of Designing and Calculation for Reinforced Concrete Structures, and have had practical experience in their Design and in the Supervision of their Construction. The candidate appointed will be required to Take Charge of the Drawing-office. An experience of Harbour Work is desirable.

Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/1285. 4222

Royal Arsenal, Woolwich. ORDNANCE FACTORIES.—LABOUR SUPERINTENDENT REQUIRED.

Candidates must be between 30 and 45 years of age and must have had workshop training in an engineering establishment and experience of general workshop conditions and questions affecting employment of civilian staff and labour, including questions of demarcations of work and machinery, piecework and wages. The upper age limit may, if necessary, be extended in the case of candidates already serving under the War Department.

Salary (to which cost-of-living bonus is added) £550, rising by annual increments of £20 to £700 p.a. Bonus on £550 at present £165 approx. The post will be pensionable, but the candidate selected will be required to serve on probation for a period not exceeding 2 years before being confirmed in his appointment.

Preference will be given to ex-Service candidates.

Form of application can be obtained from the UNDER-SECRETARY OF STATE (C.5), The War Office, Whitehall, S.W. 1. 4220

University of London.

The Senate invite APPLICATIONS for the UNIVERSITY CHAIR of ELECTRICAL ENGINEERING, tenable at King's College. Salary £1000 a year. Applications (12 copies) must be received not later than first post on 21st February, 1930, by the ACADEMIC REGISTRAR, University of London, S.W. 7, from whom further particulars may be obtained. 4114

Barking Town Urban District COUNCIL. EAST-STREET, LONGBRIDGE-ROAD AND FANSHAWE-AVENUE RECONSTRUCTION. TO TRAMWAY AND PUBLIC WORKS CONTRACTORS.

The above Council invite TENDERS for the DISMANTLING of the existing LIGHT RAILWAY TRACK, the RECONSTRUCTION thereof, including the LAYING of about 230 TONS of RAIL, and the RESURFACING of CARRIAGEWAY with Granite Setts and Wood Blocks on New Concrete Foundation in East-street, Longbridge-road, and Fanshawe-avenue.

Conditions of contract, specification and form of Tender may be obtained and drawings inspected upon application to Mr. R. A. Lay, Assoc. M. Inst. C.E., Engineer and Surveyor to the Council, at the Public Offices, East-street, Barking.

The contractor whose Tender is accepted will be required to enter into a contract under seal with sufficient security for the due performance thereof.

Tenders should be delivered or forwarded in the special envelope provided for the purpose so as to reach the undersigned not later than 7 p.m. on the 28th instant.

The Council do not bind themselves to accept the lowest or any Tender.

By Order,
S. A. JEWERS,
Clerk to the Council.

Public Offices, Barking,
9th January, 1930. 4179

The Engineer

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PUBLIC NOTICES

Bombay, Baroda and Central INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to Noon on Friday, 31st January, TENDERS for the SUPPLY of :
1. CAST STEEL WHEEL CENTRES for LOCOMOTIVES.
2. STEEL MATERIAL (BLOOMS, ROUNDS, FLATS and SQUARES).

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices, The White Mansion,
91, Petty France, Westminster, S.W. 1,
15th January, 1930. 4221

Borough of Basingstoke. ELECTRICITY DEPARTMENT.

The Electricity Committee invite TENDERS for the SUPPLY, DELIVERY and ERECTION of :—

TWO HEAVY OIL ENGINES, each direct coupled to ONE 800-kW Three-phase, 50-Period ALTERNATOR. First set to be erected and ready for service by 15th September, 1930, and the second set by 15th September, 1931.

Persons tendering will be required to send in three Tenders :—
(A) For the set to be completed by 15th September, 1930, only ;
(B) For the set to be completed by 15th September, 1931, only ;
(C) For both sets.

The Council do not bind themselves to accept the lowest or any Tender, and they reserve the right to accept a Tender for one set only.

Specifications, general conditions and form of Tender can be obtained from Mr. F. Swarbrick, Borough Electrical Engineer, Electricity Works, Brook-street, Basingstoke, on payment of a fee of One Guinea for each specification, which sum will be refunded on receipt of a bona fide Tender.

Extra copies of the specification can be obtained at a cost of Ten Shillings each, which sum will not be refunded.

Tenders, endorsed "Generating Plant," must be received by me, the undersigned, not later than first post on Saturday, 8th February, 1930.

F. H. SMITH,
Town Clerk.

Municipal Buildings, Basingstoke,
15th January, 1930. 4209

PUBLIC NOTICES

Caterham and Warlingham URBAN DISTRICT COUNCIL. MAIN DRAINAGE.

The Urban District Council of Caterham and Warlingham invite TENDERS for the CONSTRUCTION of about 6400 yards of CONCRETE and CAST IRON SEWERS, of 18in. diameter, together with all Manholes, Ventilating Shafts and other appurtenant works, in accordance with plans and specification prepared by the Engineers, Messrs. John Taylor and Sons, Caxton House, Westminster, S.W. 1.

Contractors desirous of tendering can obtain copies of the general conditions of contract, specification, bill of quantities and form of Tender from the offices of the Engineers upon payment, by cheque only, of the sum of £5 (Five Pounds), which will be returned upon receipt of a bona fide Tender.

The drawings may be inspected at the offices of the Engineers or at the Surveyor's Department, Council Offices, Harestone Valley-road, Caterham.

Sealed Tenders, endorsed "Tender for Outfall Sewer," must be delivered to the undersigned at the Council Offices, Caterham, not later than Twelve Noon on Monday, the 10th day of February, 1930.

The Council do not bind themselves to accept the lowest or any Tender.

By Order,
P. E. DIMMOCK,
Clerk of the Council.

Council Offices,
Caterham, Surrey,
14th January, 1930. 4211

County Borough of Belfast. TENDERS FOR THE SUPPLY OF LOW-LOADING REFUSE COLLECTING VEHICLES.

The Improvement Committee invite TENDERS for the SUPPLY and DELIVERY of LOW-LOADING REFUSE COLLECTING VEHICLES.

Forms of Tender and particulars may be obtained at the office of the City Surveyor, Mr. R. B. Donald, M. Inst. C.E.

Sealed Tenders, on official forms only, accompanied by drawings and specifications of vehicles tendered, enclosed in envelope supplied with the Tender forms, endorsed with the name and address of the firm tendering and marked "Tender for Refuse Collecting Vehicles, Surveyor's Department," to be lodged or posted so as to arrive in my office not later than Monday, 3rd February, 1930.

An official receipt must be obtained for every Tender delivered by hand. Tenders sent by post should be registered.

The lowest or any Tender will not necessarily be accepted.

R. MEYER,
Town Clerk.

4187

PUBLIC NOTICES

City and County of Kingston UPON-HULL. CITY ENGINEER'S DEPARTMENT. TO ENGINEERS AND OTHERS. PUMPING MACHINERY—NEW CEMETERY—EAST HULL.

The Corporation is prepared to receive TENDERS for PROVIDING and FIXING TWO 9in. VERTICAL-SPINDLE CENTRIFUGAL PUMPS complete with A.C. MOTORS, SHAFTING, SWITCHGEAR, PIPING, VALVES, &c.

Forms of Tender and other particulars may be obtained from the undersigned on payment of £1, returnable to firms submitting a bona fide Tender. Prints of the contract plan can be obtained on payment of 5s., not returnable. Remittances must be made payable to Mr. C. H. Pollard, the City Treasurer, Guildhall, Hull.

Tenders, endorsed "Tender for Pumping Machinery," are to be addressed to the Chairman of the Parks and Burial Committee and delivered to the Town Clerk's office before Noon on Wednesday, the 22nd January, 1930.

The Corporation does not bind itself to accept the lowest or any Tender.

By Order,
T. THOMAS,
City Engineer.

Guildhall, Hull,
4th January, 1930. 4178

Pembrokeshire County Council. NEYLAND LANDING STAGE.

The Pembrokeshire County Council invite TENDERS for the above WORK, comprising the Construction of a Floating Landing Stage, a Bridge leading thereto, and Alterations to an existing Timber Jetty, in accordance with the plans and specification prepared by Messrs. Wilton and Bell, Chartered Civil Engineers.

The plans, specification, and forms of contract and of Tender may be seen either at the offices of the Engineers, 57/59, Victoria-street, Westminster, S.W. 1, or at the County Offices, Haverfordwest.

Contractors will be supplied with the specification and forms of contract and of Tender, and copies of the plans may be obtained on payment to the County Council of the sum of £2 (Two Pounds), which will not be returned.

Tenders must be sent in a sealed envelope to the Clerk of the County Council, marked "Tender for Neyland Landing Stage," and must reach his office at Haverfordwest before Twelve Noon on Saturday, February 15th, 1930.

The Council does not bind itself to accept the lowest or any Tender.

ROBERT A. WHEATLEY,
Clerk of the Pembrokeshire County Council.

County Offices, Haverfordwest,
14th January, 1930. 4199

Administrative County of LONDON.

The London County Council REQUIRES a HEAD for the MECHANICAL ENGINEERING DEPARTMENT at the School of Engineering and Navigation, High-street, Poplar, E. 14.

The candidate appointed will be responsible to the Principal for the general organisation and maintenance of the department, and will be expected to give assistance on matters affecting the general welfare of the School. Details of the appointment will be furnished to all applicants.

Scale of salary in accordance with the Burnham award is £580, rising by annual increments of £25 to £725. The first increment accrues after two years' teaching service.

Apply to the Education Officer (T.1), The County Hall, Westminster Bridge, S.E. 1 (stamped addressed foolscap envelope necessary) for form, to be returned by 1st February. Canvassing disqualifies.

MONTAGU H. COX,
4201 Clerk of the London County Council.

City of Sheffield Water DEPARTMENT. BURBAGE RESERVOIR AND WORKS. RESIDENT CONSTRUCTING ENGINEER.

APPLICATIONS are INVITED for the APPOINTMENT of a qualified RESIDENT ENGINEER in connection with the Construction by direct labour of a Large Storage Reservoir on the Burbage and Houndkirk Moors, situate seven miles from Sheffield, at a salary of £1000 per annum.

The Engineer will be responsible for the preparation of all plans and designs, and for the construction of the reservoir and works connected therewith. He must be a qualified engineer and have had considerable practical experience in the design and construction of storage reservoirs, preferably formed by earthwork embankments.

The person appointed will be required to enter upon the duties at once, reside in the immediate vicinity of the works, and devote the whole of his time to the performance of his duties under the Corporation.

Applications, stating age, qualifications and experience, accompanied by copies of three recent testimonials, and endorsed "Burbage Engineer," to be sent to me not later than Tuesday, the 28th January. Canvassing will disqualify.

WILLIAM TERREY,
General Manager.

Waterworks Office, Town Hall,
Sheffield, 9th January, 1930. 4188

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PUBLIC NOTICES

County Councils—Gloucestershire, Worcestershire, Warwickshire.
RIVER AVON JOINT COMMITTEE.
APPOINTMENT OF ENGINEER (TEMPORARY).
The Committee invite APPLICATIONS for the POSITION of TEMPORARY ENGINEER to be responsible for the Completion of an Unemployment Scheme for the Improvement of the River Avon.
Experience of similar work, including dredging and the installation of sluices, an advantage.
Copies of testimonials, together with application, stating salary, to be forwarded to the undersigned not later than February 7th.
E. T. GARDOM,
Clerk of the County Council.
Shire Hall, Gloucester. 4191

Municipality of Singapore,
STRAITS SETTLEMENTS.
WATER DEPARTMENT.
ASSISTANT WATER ENGINEER.
ADVERTISEMENT.
The Municipal Commissioners of Singapore REQUIRE an ASSISTANT ENGINEER for the permanent staff of their Water Department, the appointment being in the first instance on a three years' agreement.
Candidates should be between 21 and 23 years of ge and unmarried. Preference will be given to applicants possessing a good University Degree in Civil Engineering, irrespective of their practical experience; but consideration will be given to applicants who have passed Sections A and B of the Assoc. M. Inst. C.E. examination and have completed several years' work with a qualified civil engineer in general (not necessarily waterworks) practice.
Strict medical examination.
Salary $280 dollars, $760 dollars and $240 dollars per annum respectively for the three years of the agreement, and rising thereafter (if service be continued) to a maximum of $600 dollars per annum. The exchange value of the dollar is 2s. 4d. sterling, at which rate the salary for the first year would amount to £316. There is at present no income tax.
Free first-class passage will be provided with half salary during the voyage out.
An allowance for transport on duty will be granted.
Eight months' leave with full pay is normally granted after four years' service. Liberal Provident Fund.
Applications, stating whether married or single and giving age and birthplace, with details of education, training and experience, and referring particularly to the qualifications mentioned above, and accompanied by copies (not originals) of testimonials, to be lodged with Messrs. PEIRCE and WILLIAMS, MM. Inst. C.E., 1, Victoria-street, London, S.W. 1, Agents to the Commissioners, not later than Monday, 27th January, 1930.
Further particulars, if desired, can be obtained from the Agents. 4189

Municipality of Singapore,
STRAITS SETTLEMENTS.
ELECTRICITY DEPARTMENT.
ASSISTANT POWER STATION SUPERINTENDENT.
ADVERTISEMENT.
The Municipal Commissioners of Singapore REQUIRE an ASSISTANT POWER STATION SUPERINTENDENT, age not exceeding 40 years, for service at their new Power Station, the appointment being on the permanent staff of their Electricity Department, and being in the first instance upon a three years' agreement.
The capacity of the plant is over 20,000 kilowatts.
Candidates should have a thorough experience in Extra High-tension Three-phase Generation, Steam Turbines, Water-tube Boilers and Mechanical Stokers, and must have held a similar position previously. Preference will be given to Corporate Members of the Institution of Electrical Engineers, and the possession of a First-class Board of Trade Engineer's Certificate is desirable.
The selected candidate will be required to deputise for the Power Station Superintendent and will be expected to take shifts when necessary.
Strict medical examination.
Salary 6240, 6720 and 7200 dollars per annum respectively for the three years of the agreement, and rising thereafter, if service be continued, in accordance with the Commissioners' Salary Scheme. The exchange value of the dollar is 2s. 4d. sterling, at which rate the salary for the first year would amount to £738. There is at present no Income Tax. Free partially furnished quarters provided, with an allowance for lighting.
Free passage will be provided with half salary during the voyage out, and if the selected candidate is married, passages will be provided for his wife and family (if any). Eight months' leave with full pay is normally granted after four years' service. Liberal Provident Fund.
Applications, stating whether married or single, and giving age and birthplace, with details of education, training and experience, and referring particularly to the qualifications mentioned above, and accompanied by copies (not originals) of testimonials, to be lodged with Messrs. PEIRCE and WILLIAMS, MM. Inst. C.E., 1, Victoria-street, London, S.W. 1, Agents to the Commissioners, not later than Monday, 27th January, 1930.
Further particulars, if desired, can be obtained from the Agents. 4219

The Institution of Structural Engineers invite APPLICATIONS for the POST of SECRETARY.
Candidates must have had secretarial experience, combined with a general knowledge of the engineering profession; competent acquaintance with modern languages is desirable in view of the Institution's present activities.
Applications, giving previous experience and stating salary required, must be addressed under sealed envelope to the PRESIDENT of the Institution of Structural Engineers, 10, Upper Belgrave-street, Westminster, S.W. 1, and the envelope must be endorsed in the top left-hand corner "Secretaryship—Private." 4190

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

CEMENT BURNER REQUIRED for British Colony in the East. Congenial climate. Salary £35 per month plus £7 per month house allowance; three years' agreement. Free passages.—Write, Box A.L., c/o Davies and Co., 95, Bishopsgate, London, E.C. 2. 4196 A

EDITORIAL MAN, with Sound Electrical Training and experience, REQUIRED by a leading firm. Age 25 to 30; a Degree in Engineering is desirable. Applicants should give full qualifications, salary, &c. —Address, 4184, The Engineer Office. 4184 A

ELECTRICAL and MECHANICAL ENGINEER REQUIRED for service in Algeria; must have had experience with A.C. Plant Transformers, Motors, &c. Capable of testing and carrying out electrical and mechanical repairs. Preference given to experience with Transporters and Coal-handling Plant, also knowledge of French desirable.—Write, giving full particulars and salary required, to Box L. H., c/o Cowles, 17, Gresham-street, E.C. 2. P6576 A

ELECTRICAL ENGINEERS, London, W.—Well-known firm—REQUIRE experienced ENGINEER capable of Laying-out Production Methods for Small and Medium-sized Products; must possess first-class knowledge of up-to-date machinery, tool design. State salary. Previous references extremely important. —Address, 4213, The Engineer Office. 4213 A

ENGINE TESTER WANTED. Experienced with Two-stroke Cycle Cold-starting Oil Engines up to 200 H.P. Man with drawing-office and outdoor experience preferred.—Box No. 242, Brown's Advertising Agency, 166, Buchanan-street, Glasgow. 4180 A

EXPERIENCED ESTIMATING ENGINEER, Accustomed to full responsibility for tenders, REQUIRED by Manufacturers of Turbo-generator Plant. Applicants should state age, training, experience, and salary required.—Address, 4193, The Engineer Office. 4193 A

YARROW HOME and HOSPITAL
FOR CHILDREN
BROADSTAIRS.

For the Early & Preventive Treatment of Disease & Convalescence after illness.

In these days of high cost of living, people of limited means are sometimes placed in a difficulty when their children are ill or need operations and afterwards require a change of air and much careful attention during convalescence. It cannot be too well known that the Yarrow Home and Hospital for Children, Broadstairs, Kent, was founded specially for the children of those who are not too well endowed with this world's goods. At this Home a child recovering from illness or an operation, or needing a long course of medical or surgical treatment, receives, amid the happiest possible surroundings and companionship, careful nursing and attention, such as could ordinarily only be obtained at expensive nursing homes. There are beds for fifty boys between the ages of four and twelve years, and for fifty girls between the ages of four and fourteen years. In special cases these age limits may be exceeded by two years. The fee is one guinea per week and travelling expenses. Applications for the entrance of patients are welcomed from professional people, such as members of the Institution of Civil Engineers, architects, artists, authors, clergymen, members of the medical, legal, and other professions, members of scientific societies, officers of the Navy, Army, and Royal Air Force, officers of the merchant navy, school masters, university professors, &c. The London office is at 116, Victoria-street, Westminster, and the Secretary will be pleased to send full particulars to anyone who is interested.

SITUATIONS OPEN (continued)

HEAD COSTING CLERK; Wide Experience costing of small parts in large quantities. Only first-class man with modern ideas need apply, stating salary and full particulars of past experience.—Address, 4195, The Engineer Office. 4195 A

INDUSTRIAL ENGINEER, Age 28-35, Sound Technical education, a University Engineering Degree preferred. Four to five years' practical shop experience essential. Position offers attractive financial future. Post in Great Britain.
Candidates, in replying, should state age, present salary, and general qualifications.
Address, P6596, The Engineer Office. P6596 A

LEADING INSURANCE OFFICE REQUIRES the SERVICES of an additional CRANE SURVEYOR. Age 26 to 28 years. Applicants must have a sound practical and theoretical knowledge of all types of Cranes and be able to make intelligent reports and sketches of the various parts. The appointment will be strictly subject to medical fitness. Commencing salary £260 per annum.—Address applications, giving full particulars as to training and experience, 4223, The Engineer Office. 4223 A

REQUIRED AT ONCE (Manchester Area) by Progressive old-established Firm of Electrical and Mechanical Engineers, really competent MAN, to Take Charge of and Develop along most modern lines a well-equipped Foundry undertaking all branches of iron and non-ferrous work. Exceptional opportunity for young expert with practical and technical training, having knowledge of Engineering and Pattern Shop Practice and who is capable of estimating and fixing piecework prices.
State full experience, age, and salary required.
Address, 4203, The Engineer Office. 4203 A

TRAVELLER for Railway and Ships' Brassfoundry. State age, experience, and salary.—Address, 4217, The Engineer Office. 4217 A

WORKS ACCOUNTANT REQUIRED, Accustomed to supervision and operation of costing system on large production scale.—Address, stating age, experience, and salary, 4225, The Engineer Office. 4225 A

WORKS MANAGER REQUIRED in Engineering Factory. Must have first-class practical experience in production of General Machinery, Riveted and Welded High-pressure Mild Steel Vessels. Good organiser with up-to-date methods.—Address, stating age, full experience and training, also salary required, 4210, The Engineer Office. 4210 A

WANTED, JUNIOR DRAUGHTSMEN for Elevator and Conveyor Work in large works in the Midlands.—Write, stating age, qualifications, when at liberty, and salary desired, 4216, The Engineer Office. 4216 A

DRAUGHTSMAN, Experienced in Estimating and Design of Steam and Hot Water Heating Systems, for Birmingham district. Progressive position.—Address, with full particulars, 4119, The Engineer Office. 4119 A

DRAUGHTSMAN REQUIRED, Experienced in designing and detailing Steam and Electric Jib Cranes.—Apply, with full particulars of experience and salary required, to HENRY J. COLES, Ltd., London Crane Works, Derby. 4208 A

DRAUGHTSMAN REQUIRED IMMEDIATELY, London. Must be used to Furnace Design and Gas Producer Work. Excellent prospects for right man. State age, experience, and salary required.—Address, 4197, The Engineer Office. 4197 A

DRAUGHTSMEN REQUIRED, Used to Automobile Engineering.—Apply by letter, stating age, salary, and experience, to SINGER and CO., Ltd., Canterbury-street, Coventry. 4130 A

ELECTRICAL DRAUGHTSMEN.—YOUNG MEN REQUIRED in Factory Engineer's Office; must be quick and accurate, used to Plant Maintenance, D.C. and A.C. Fares paid if interviewed.—Write fully first instance, giving experience, age, salary, and if disengaged, EMPLOYMENT DEPT., Standard Telephones and Cables, Ltd., New Southgate, London, N. 11. 4185 A

FIRST-CLASS STRUCTURAL DRAUGHTSMAN REQUIRED by a Large Firm of Constructional Engineers on the North-East Coast. Must be capable of designing and calculating stresses without constant supervision.—Write, stating age, experience, and salary required, Z.J. 821, c/o Deacon's Advertising Agency, Fenchurch-avenue, E.C. 3. 4224 A

JIG and TOOL DRAUGHTSMEN REQUIRED for General Engineering Works.—Address, stating age, full details of experience, and salary required, 4133, The Engineer Office. 4133 A

JUNIOR JIG and TOOL DRAUGHTSMAN REQUIRED.—Apply by letter, stating age, salary, and experience, to SINGER and CO., Ltd., Canterbury-street, Coventry. 4131 A

LADY TRACER REQUIRED AT ONCE. West London district. One with experience of Aero-engine Work preferred.—Address, stating age, experience, and salary required, 4200, The Engineer Office. 4200 A

LEADING FIRM of OIL ENGINE MAKERS DESIRES to APPOINT a highly qualified DRAUGHTSMAN experienced in latest designs of Heavy Oil Engines of vertical multi-cylinder four-stroke "cold-start" types. Preference given to applicants with intensive knowledge of high-speed light-weight types up to about 50 B.H.P. unit. A generously salaried and permanent appointment awaits the right man. Applications will be treated as strictly confidential. Age and experience to be stated. —Address, 4206, The Engineer Office. 4206 A

MECHANICAL DRAUGHTSMEN REQUIRED for Light Mechanical Work by an Electrical Firm in the Midlands. Preferably experience on Mechanisms. Good opportunities.—Address, stating age, experience, salary required, 4146, The Engineer Office. 4146 A

SITUATIONS OPEN (continued)

METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., REQUIRE DRAUGHTSMEN with experience of Marine Motor Control.—Apply, with particulars of age, experience, and salary required, to the COMPANY'S EMPLOYMENT DEPARTMENT, Trafford Park, marking envelope "Marine Control Draughtsman." 4137 A

OPERATION PLANNING AND RATEFIXING DEPT.—Live, energetic and experienced MAN REQUIRED to Take Charge of above in General Engineering Works. Applications must state age, full particulars of experience, and salary required, and will be treated in confidence.—Address, 4174, The Engineer Office. 4174 A

STRUCTURAL DRAUGHTSMAN REQUIRED. One used to Carbonising Plant preferred.—State experience and salary required to Z.S. 831, c/o Deacon's Advertising Agency, Fenchurch-avenue, E.C. 3. 4226 A

COLONIAL RAILWAY REQUIRES FOREMAN to Take Charge of Carriage Shops. Thorough knowledge of Coach Body Repair Work essential and experience in Building New Stock desirable. Healthy climate, good salary, conditions and prospects for first-class man, age 35 to 44, with character and personality. Applications, which will be treated in strict confidence, should be accompanied by full particulars of experience and present employment.
SIR DOUGLAS FOX and PARTNERS, Broadway Buildings, London, S.W. 1. 4198 A

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A Seven-Day Journal

Professor A. A. Michelson.

WE are delighted to find that in common with the French Academy of Sciences and many leading journals in France and in this country we owe Professor Albert Abraham Michelson an apology for reporting, as we did last week, that he had died. He is, it is stated, at the present moment visiting Bermuda on a holiday. No explanation has been given as to the origin of the report concerning his death. The announcement on which it was based was made at a meeting of the French Academy. We leave it to that distinguished body to explain how it came to mislead a large part of the world into believing that one of its most celebrated physicists had departed from its midst. We sincerely trust that the news that he is still alive and active is well founded.

The North-East Coast Exhibition Buildings.

IT is officially announced that the Disposal Committee of the North-East Coast Exhibition, Newcastle, has accepted the tender of Thos. W. Ward, Ltd., Sheffield, for the Palaces of Engineering and Industry, and other buildings, stands, and structures. There are about twenty large buildings, with floor space ranging from 176,000 square feet down to 600 square feet. They are mostly constructed of steel and timber framing, with weather board and asbestos sheeting sides, wooden floors, and Ruberoid roofs. The grand-stand in the Stadium is 150ft. long by 50ft. wide, and is capable of seating about 3000 people, and there are numerous large and small kiosks. The purchase does not include the Palace of Arts, the bridge over the lake, nor the pylons and fencing, all of which have been acquired by the Newcastle Corporation. It is expected that the buildings and structures will be dismantled for re-use and re-erection in other parts of the country, and that the site will be cleared before the middle of May in order that the ground may be returfed and restored to its original condition.

Subways Beneath London Streets.

ON Tuesday, a meeting, convened by the London County Council, was held at the L.C.C. Hall, of representatives of public authorities and utility undertakings for the purpose of urging the Government to institute an inquiry into questions relating to subways beneath the streets of London. Eventually, a resolution was passed with but two dissentients asking the Government to undertake such an inquiry. Mr. H. E. Stilgoe, chief engineer of the Metropolitan Water Board, moved a resolution to the effect that while it was not practicable in the majority of existing streets to incur the heavy expense involved in the construction of subways, it was desirable that in all new arterial roads, or in cases of considerable widening or reconstruction of existing traffic arteries, provision should be made for subways for the accommodation of pipes, sewers, &c. The representatives of the London Power Company, the Gas Light and Coke Company and the South Metropolitan Gas Company declared themselves opposed to laying electric cables or gas mains in subways on the grounds either of the danger of flooding, of the fusing of electrical cables, or of damage by bombs in war-time. Among those supporting the motion were the representatives of the General Post Office, the City of London Police and the London Hydraulic Power Company. The resolution was carried by a majority. The Clerk to the Westminster City Council, on behalf of the Metropolitan Boroughs Standing Joint Committee, moved a resolution intended to eliminate the legal difficulties placed in the way of Borough Councils when they desired to construct subways. Borough Councils owned the surface of the road, he said, but not the subsoil. Before they could construct a subway they had to obtain the consent of the Ministry of Transport and had to buy the subsoil. Even then their intentions might be baulked by the rights of statutory undertakings, and if mains or cables had to be moved an order had to be obtained from the Development Commissioners. Subject to the establishment of an over-riding authority to restrain the boroughs in doing as they liked in the construction of subways, the resolution was carried.

The Late Sir Thomas Matthews.

IT is with great regret that we have to put on record the death of Sir Thomas Matthews, which took place on Monday of this week, January 13th, at Torquay. Thomas Matthews, who was the son of the late John Matthews, of Penzance, was born on August 28th, 1849. He had, therefore, passed into his 81st year. He was educated locally, and at the age of twenty-four he became an assistant in the Engineering Department of Trinity House, in the service of which body he passed the whole of his professional life, becoming Engineer-in-Chief in 1892. Under his superintendence a great many lighthouses were built, and a large number of improvements were carried out in various directions. Among the latter may be mentioned the substitution of incandescent gas burners for oil lamps, and the employment of automatic flashing buoys and beacons. At the Board's works on the north bank of the Thames, many ingenious contrivances were designed and manufactured, and among them were clever clockwork arrangements by which lights were automatically lit and extinguished at the correct hours according to the varying seasons of the year. Several of these devices we had the pleasure of illustrating and describing at the times when they were introduced. He also effected improvements in coast signals and introduced a manually operated fog signal for use on lightships. As early as 1881 Matthews was chosen to proceed to the East in order to make a report on the proposed construction of a lighthouse on the Island of Minicoy in the Indian Ocean. He also became adviser on lighthouse matters to the Crown Agents for the Colonies and the India Office, and was responsible for the design of the lighthouse on Cape Pembroke in the Falkland Islands. Sir Thomas, who received a knighthood in 1909, was for some time Member of Council of the Institution of Civil Engineers.

A Reconditioned Australian Liner.

THE 13,840 gross ton twin-screw liner "Hobson's Bay" recently arrived in London to take up her service in the Australian trade of the Aberdeen and Commonwealth Line, which is managed by the Shaw, Savill and Albion Company, Ltd., of London. She was built and engined by Vickers Ltd. in 1922, and since her arrival at Wallsend in September last, she has been reconditioned and her machinery overhauled. She has a length of 530ft. 6in. with a beam of 64ft. 3in., and is now designed to carry 742 passengers of one class and cargo. The main dining saloon has been enlarged to seat 375 persons, and new public rooms include a smoking-room and a verandah *café* on the boat deck. The cabin accommodation has also been reconditioned. As well as overhauling the double reduction geared turbine machinery and auxiliary equipment an opportunity has been taken to install a complete new system of ventilation in the engine-room. New lifeboat davits have also been fitted and two sets of Colombus-type davits, with eight Welin-type davits, are now carried. When the "Hobson's Bay" arrived at Wallsend, Swan, Hunter and Wigham Richardson, Ltd., had just competed the sister liner "Jervis Bay," and these two ships will form an important addition to the one-class steamers in the Australian service. These "Bay" class ships were originally owned by the Australian Government, and it is hoped that they will be entirely successful on their new service.

The Southern Railway Co's. Programme.

A TOTAL sum of £4,300,000 will be expended in carrying out the programme of new works authorised for this year by the directors of the Southern Railway. Included in the programme are twenty 2–6–0 express passenger engines, similar to the "U" class now in service, ten three-cylinder goods engines, 300 corridor coaches, sixteen restaurant cars, 130 vans of various types, and 2000 trucks of different kinds. These engines and vehicles will cost £1,195,000, and, in addition to them, a number of special coaches will be built in connection with the extension of the electrified system to Brighton. A sum of £21,610 is to be spent on the provision of thirty-five road motor vehicles, and a sum of £386,000 on the reconstruction or extension of certain stations, &c. In addition to these new works, a large sum of money is to be expended on the completion this year of various works of reconstruction begun previously. On new electrification schemes, a sum of £159,500 is set aside for the 14 miles of line between Dartford and Gravesend, £72,000 for the 8 miles of track between Wimbledon and West Croydon, and £366,000 for the 27¼ miles between Twickenham and Windsor. It is hoped that these three lines will be ready for electrified operation when the summer train services are brought into force. On the marine side the chief item of expenditure this year will be a sum of £800,000, which has been earmarked for the docks extension scheme now being carried out at Southampton. At Newhaven and Folkestone harbours sums of £24,000 and £26,000 respectively are to be expended on the provision of electric cranes. During the year two new Channel Island steamers, two new Portsmouth–Ryde paddle steamers, and a new Isle of Wight motor car ferry boat will be brought into service. These five vessels represent an expenditure of £481,000.

Flood Prevention in the Thames Valley.

AT the annual meeting of the Thames Conservancy held in London on Monday, the Chairman, Lord Desborough, referred to the recent severe flooding in the Thames Valley, and mentioned some of the suggestions for preventing its repetition which the Conservancy had received. The simple suggestion that the river should be embanked overlooked the fact that the river had a number of tributaries, each of which would also have to be embanked. Another suggestion was that the flood water should be impounded in specially constructed reservoirs. It was calculated, Lord Desborough stated, that to absorb 1in. of rainfall six reservoirs, each with an area of 3¾ square miles and a depth of 15ft., would be required. During October, November, and December the aggregate rainfall exceeded 17in. A third suggestion was that the river should be provided with a new channel extending from near Wraysbury to Bognor. Such a scheme would affect only certain reaches of the river. In addition, the water deflected into the new channel would have to be lifted 120ft. over the watershed between the Thames Valley and the sea. Referring to the Wey Valley drainage scheme, now practically sanctioned, Lord Desborough said that far from solving the problem of Thames flooding, it would only make matters worse. If all the tributaries were to be allowed to pour their flood water into the Thames, the river would become one huge pond. The Thames Conservancy, he added, was not created to deal with floods. It had never been given the power or the money to do so. It had never been authorised to acquire land compulsorily, to make channels, and to deal with floods in the only possible way in which they could be handled.

Shipbuilding in America.

ACCORDING to the shipbuilding returns for American yards, the output during 1929 showed an increase of 22·3 per cent., compared with that of the previous year. The tonnage on order at the beginning of this year represented an increase of 24·4 per cent. over that of last year. During the past year, construction was undertaken at sixty-three yards, compared with forty-four in 1928, fifty-one in 1927, and forty-one in 1926. The total output during 1929 was 544 ships of all types, aggregating about 284,226 gross tons. Of these vessels 27·1 per cent. were steamships, 15·7 per cent. motor ships, and the remaining 57·2 per cent. barges and other non-propelled vessels. Reports received from forty-eight shipyards show that 215 merchant ships, totalling 359,460 gross tons, are now under construction, and of these 67·8 per cent. are steamships, 21 per cent. motor ships, and the remaining 10·4 per cent. barges and other small craft. Practically all the new ships are being built in shipyards on the Atlantic and Gulf coasts, although some construction is taking place on the Great Lakes, and the Western River and Western Coast yards. Of the larger ships in hand, two 18,500-ton liners for the Matson Navigation Company, which are being built by the Bethlehem Shipbuilding Corporation, while the Newport News Shipbuilding and Drydock Company is constructing two 21,000-ton liners for the Dollar Steamship Company and two 11,300-ton liners for the Ward Line. These four ships will be propelled by turbo-electric machinery.

The Late Mr. Henry Alabaster.

WE regret to have to record that Mr. Henry Alabaster died on Monday, January 13th, after a brief illness. Mr. Alabaster was born in London in August, 1846, and was therefore in his eighty-fourth year at the time of his death. In 1874 he became interested in the *Telegraphic Journal and Electrical Review*, which had been started on November 15th, 1872. His connection with that journal was continuous until the day he died. For many years he was in partnership with the late Mr. T. E. Gatehouse, and with Mr. H. R. Kempe, in the firm of H. Alabaster, Gatehouse and Co. When in 1919 the business was formed into a limited liability company, the Electrical Review, Ltd., he became its chairman and managing director. That office he continued to hold until last autumn, when he resigned because of advancing years, but he remained a director to the end. Although not strictly an electrical engineer, he was interested in most of the movements affecting the electrical profession and industry which occurred during the period of fifty-six years covered by his association with them. In 1887 he was elected an associate of the Institution of Electrical Engineers, and for some years was joint auditor with the late Mr. Sidney Sharp, of the Institution's accounts. He was an early member of the society known as the Dynamicables, and was one of the founders of the Electro-Harmonic Society. In 1901 he presided at the meeting held in London at which the Electrical Contractors' Association was formed.

Civil Aviation in the United States.

THE immense developments on the manufacturing side of the civil aviation industry in the United States have not, it seems, so far been accompanied by a proportionate development in the use made by the public of the aerial services which have been established. According to the United States Post Master-General the public's lack of confidence in air transport and inadequate subsidies have produced heavy deficits for most of the aviation companies and have reduced them to a state in which the very life of the passenger transport industry is in the balance. At present there are about 200 machines and 250 pilots engaged in operating 14,000 miles of air mail routes in the United States, the aggregate distance flown amounting to about 40,500 miles per twenty-four hours. On the passenger transport side only those companies operating short services extending from ten to thirty minutes in the air are earning profits. The long-distance companies are reducing their fares to, or even below, the level of railway fares.

Harbours and Waterways in 1929.

THE increase of activity in port improvement, both at home and abroad, which we mentioned in our review of progress a year ago, seems to have been maintained throughout the year 1929. A few great works have been completed; a few have been begun and more than a few schemes have been the subject of discussion. Among the last have been several old proposals which have been brought out anew in the hope that they might participate in the shower of gold which enthusiastic optimists imagined would result from Mr. J. H. Thomas's efforts to relieve unemployment. So far as port works are concerned, the only proposal of considerable magnitude which appears to be the outcome of the encouragement given by the present Government is that of the Great Western Railway Company to build a new entrance lock at Swansea. The Grimsby dock extensions which are about to be begun were the subject of a late Bill deposited early in 1929, and the Act authorising the works was obtained in the lifetime of the late Government. The Bills deposited in the present session of Parliament, with the exception of the Great Western Railway Bill, indicate that very little new dock construction in home ports is likely to be undertaken in the near future. On December 10th, Mr. Thomas introduced in the House of Commons a proposal to expedite the consideration of Private Bills containing provisions relating to work which would relieve unemployment. These proposals are intended to be a temporary expedient.

THE UNITED KINGDOM.

Port of London.

The Tilbury dock improvements begun by the Port of London Authority in 1926 were officially opened on September 26th by Lady Ritchie of Dundee. These works have been completed before the prescribed time by the contractors—Sir Robert McAlpine and Sons, Ltd.—and include a new entrance lock 1000ft. long and 110ft. wide internally, and a dry dock of similar width, which is the largest in the Port of London. We described and illustrated the new Tilbury works in our issue of September 27th last. The full scheme is not yet completed, but the floating landing stage and new railway terminus for overseas shipping which are being built to the east of the old Tilbury entrance are nearing completion, and a large part of the floating stage is already in use. The last of its four sections was placed in position in May.

At the West India and Millwall docks the principal works of reconstruction have now been completed and the modernisation of the equipment is continuing. The most recent section of the latter to be undertaken is the construction of transit sheds and warehouses and the provision of quay equipment at the South Dock, affecting about 5750ft. of quayage. A contract for these works was placed by the Port Authority in March, 1929. The new swing-bridge spanning the Millwall passage is now in use, and the new entrance lock at Blackwall, which now forms the main approach to all the docks in the Isle of Dogs, was opened on September 5th, 1929. The lock works, begun in August, 1927, were, like the Tilbury extensions, finished in less than the contract time. The new lock is 590ft. long and 80ft. wide internally, with a depth of 35ft. at T.H.W. It occupies the site of the old lock, 480ft. by 54½ft., and originally the site of the entrance lock to the canal, made about 120 years ago, across the Isle of Dogs. The completion of these works places the West India Dock system in a position to accommodate a class of shipping much larger than the vessels which have hitherto made use of the docks lying above the King George V. Dock.

Another work on which the Port of London Authority is engaged at present is the development of the Lavender and Acorn Ponds of the Surrey Commerical Docks, begun in 1928, for the accommodation of timber vessels. The scheme includes new discharging berths, with a quay 1580ft. long, timber storage sheds and an impounding station.

The Port Authority has expended about £2,550,000 on the Tilbury docks improvements, and the total cost of the scheme of development begun in 1925 will, when the Tilbury landing stage, the improvements at the West India and Millwall docks and the Surrey Commercial docks are completed, amount to nearly £5,000,000.

A decision has been arrived at regarding the future of the old western entrance to the Royal Victoria Dock which had been temporarily closed. The lock is now being strengthened and adapted for the use of barge traffic, the access to the dock for large vessels being through the Royal Albert Dock.

An interesting reconstruction of an ancient Thames waterway was brought to a conclusion in July, when the Grosvenor Dock on the riverside behind Victoria Station was opened as a barge depôt for refuse disposal by the Westminster City Council. The new entrance lock and a basin have been formed on the site of the remains of the old Grosvenor Canal, the history of which goes back for over two centuries. The canal had been used by the City Council since 1906 for barging refuse. A part of the waterway has now been filled in, reclaiming about 2½ acres of land for use as a refuse depôt, and a convenient barge basin and a larger entrance lock giving access from the river have been constructed.

In our review of a year ago we referred to the abnormal high tide in the Thames on the night of January 6th–7th, 1928. The Air Ministry issued in July, 1929, a very valuable memoir giving the results of the investigations made by the Liverpool Tidal Institute and the Meteorological Office following on the disastrous flooding from the river. These reports are of great interest not only to those concerned with the *régime* of the river Thames, but to others who are responsible for the conservancy of tidal rivers in other parts of the world.

The Mersey and the Manchester Ship Canal.

The modernisation of the Alfred Dock, Birkenhead, has been completed by the opening of the new 80ft. wide inner passage between the dock and the large enclosed water space known as the Great Float. The passage is closed by a single pair of gates, similar to those placed in the river entrance lock which was opened in July, 1928, and is spanned by a swing road-bridge. The passage works and bridge were opened to traffic in February. The Mersey Docks and Harbour Board has recently expended about £1,250,000 in connection with dock development work at Birkenhead. The Dock Board, it is understood, proposes to carry the modernising of the older docks at Liverpool and Birkenhead a stage further by equipping them with new cargo-handling appliances and new sheds where required to bring them as nearly as possible up to the standard of the new Gladstone Dock. The scheme is expected to cost upwards of £1,500,000.

Improvements are being made at the Prince's Dock on the Liverpool side of the Mersey in order to accommodate the larger steamers now employed in the Irish coastal trade. The northern entrance is being widened from 44ft. 3in. to 60ft. and the depth increased by 2ft. The Clarence Dock site has been sold to the Liverpool Corporation for the erection of a large power station and the dock is being filled up. During the past financial year 18½ million tons of sand were removed from the Bar and the sea channels of the Mersey by the Dock Board dredgers.

The construction of the rubble stone training bank on the West side of the Crosby Channel, which is known as the Burbo training bank, was completed, so far as is at present intended, during the summer of 1929, and that on the East side of the channel has been begun. The east training bank is to be about half the length of that on the west side, which is nearly 3½ miles.

The new dock for Lever Bros., Ltd., at Bromborough, on the Cheshire side of the Mersey, is not expected to be ready for use for over a year.

Bristol Channel and South Wales Ports.

The Great Western Railway Company is seeking parliamentary powers to construct—among other works—a new entrance lock to the King's Dock at Swansea. It is understood that a substantial sum towards the cost of the lock, estimated at approximately £1,000,000, will be contributed by the Government in connection with the scheme for assisting public utility undertakings. At present all the wet docks at Swansea comprised in the King's Dock system, with a water area of nearly 250 acres, are entered through one large lock opened in 1909. For some years past the old and smaller Prince of Wales' lock has been closed and abandoned as an entrance. The need of a second lock has long been felt, not only to cope with the traffic using the docks, but also as a provision for entrance and exit in case of any accident to the existing King's Dock lock. It was, in fact, found necessary in the summer of 1929 to close this lock to large ships for the first time in twenty years to enable certain urgent repairs to the gates to be carried out, and for about ten days no ships, with the exception of small craft, were able to enter or leave the docks. The Great Western Company has begun the filling in of the old North Dock at Swansea for the closing of which powers were obtained from Parliament in 1928. The company is still actively engaged in modernising the coal shipping appliances in the South Wales ports. Belt conveyors for coal shipment are being provided for the Roath Dock at Cardiff, and two movable hoists and traversers at the Alexandra Dock there.

Southampton, Cowes and Newhaven.

The thirteen million pounds scheme for the Southern Railway at Southampton is making progress. The reclamation bank on the margin of the reclaimed area has now been brought up to above high-water level for the greater part of its length. An opening in the bank at its northern end is crossed by a temporary trestle. The sinking of the concrete monoliths for the quay wall through the temporary bank and the underlying strata was begun by the contractors, Sir R. McAlpine and Sons, early in the year. The work of sinking was delayed somewhat by difficulties; the strata in some places cannot be removed from within the wells by simple grabbing, and powerful water jets are being experimented with. The contractors for the dredging and reclamation work, the James Dredging, Towage and Transport Company, Ltd., have a fleet of dredgers, barges and pump-ashore craft busily employed in dealing with the 10,000,000 tons of spoil involved in this part of the work. It is expected that the first section of the new quay, 1000ft. long, with 45ft. depth of water alongside it at low water, will be ready for occupation early in 1931. The culverts, for carrying storm water discharge and for the intake and discharge of river water for the Corporation's electricity supply station which cross the area of about 170 acres of mud land reclaimed from the river Test, are now nearing completion. This work is being carried out by Charles Brand and Sons, who are also the contractors for rebuilding and remodelling the Medina Wharf at Cowes for the Southern Railway. The reconstruction of the East Pier at Newhaven Harbour, begun by the Southern Railway Company in 1928, is still in progress, and the crane equipment at the port is to be electrified.

North-East Coast and Humber Ports.

The Tyne Improvement Commissioners have already decided to make an extension of the riverside deep-water quay at the Albert Edward Dock, North Shields, which was completed and brought into use only eighteen months ago. Smith's Docks Company in October opened a new dry dock at North Shields which takes the place of that company's old No. 5 Dock. The new structure has available internal dimensions of 480ft. length and 68ft. width of entrance with a depth of 24ft. over the sill at high water. The pumping plant of the neighbouring No. 6 Dock is utilised for dewatering the new dock, and the site of the old No. 5 Dock has been made use of for oil storage and provides room for a very complete equipment of ship repairing plant. The new and enlarged entrance at Hawthorn, Leslie and Co.'s Hebburn dry dock was brought into use during the year. This dock had been out of service for several years since an accident which resulted in the wrecking of the caisson, formerly used for closing the entrance, and other damage. The new entrance is closed by a single steel gate hinged on a horizontal axis at the sill level.

The most important development at the present time in connection with the London and North-Eastern Railway Company's dock undertakings is the new fish dock at Grimsby, which, although it is to be constructed nominally by the Grimsby Corporation with money raised by it and with the assistance of a Government grant, has been designed by the railway company's engineers and will, when completed under their supervision, be leased by the company. The necessary parliamentary powers were obtained last session and it is expected that work will be begun early this year. The cost is estimated at £1,418,000. The railway company has also decided to carry out a reconstruction scheme at the Grimsby Royal Dock, which includes rebuilding transit sheds and the substitution of electric cranes for the present hydraulic cranes at a cost of £100,000. The railway company is seeking powers by a Bill deposited this session to close the old Queen's Dock at Hull, opened 150 years ago, and sell the site of 10½ acres to the Corporation. Powers are also sought to close the old lock, another relic of Georgian times, at the Alexandra Dock, Grimsby. At Hull the existing coal tipping appliances in the older docks are to be adapted for dealing with 20-ton wagons, thus bringing them into line with the more modern equipment of the King George Dock, which is already equipped for dealing with large wagons.

The covered landing stage for the fish trade at the St. Andrew's Dock, Hull, which was completed and brought into full use during the summer, was badly damaged by fire a few weeks later, when the whole of the sheds, fish buyers' offices and other erections on the deck of the reinforced concrete wharf were destroyed.

The L.M. and S. Railway Company and the Aire and Calder Navigation are jointly preparing plans for dock improvements at Goole, to cost £110,000. Most of the proposed work is in connection with the north side of the West Dock.

Work on the training banks to improve the navigable channel of the river Ouse where it enters the Humber is making good progress, and the construction of the training bank in the river Trent has begun.

At Sunderland the River Wear Commissioners have commenced the construction of the new coal staiths and belt conveyors at the Hudson Dock.

The Unemployment Grants Committee has recommended a grant in aid of the Tees Conservancy Commissioners' project for deepening and widening the river and reclaiming the Seal sands on the north side of the Tees entrance. It is understood that the work will be begun early this year. The London and North-Eastern Railway Company has abandoned the project to build a deep-water dock near the mouth of the Tees, for which a large area of land on the Yorkshire side of the river was acquired some years ago by the company. This decision is keenly regretted by Tees-side interests, and it should be noted that Middlesbrough is one of the ports which is specially recommended for improvement in the report of the Port Development Committee to which reference is made, hereunder.

Scotland.

The Leith Dock Commissioners brought into use in August a new concrete wharf, 1000ft. in length,

which they have built at a cost of £160,000 in the outer harbour at Leith. The Commissioners have also placed an order recently for three 30-ton coal hoists, which are to be erected at the Imperial and the Edinburgh docks. At Glasgow the L.M. and S. Railway Company and the Clyde Navigation Trustees are considering schemes for improving the coal shipping facilities on the Clyde. It is probable that belt conveyors will be substituted for some of the cranes still in use for shipping cargo and bunker coal. The Greenock Harbour Trustees have prepared a scheme, estimated to cost £175,000, for extending the Princes Pier westward by 800ft., and providing berths, with a depth of 45ft. at high water, alongside the extension. This deep-water extension is intended for berthing Transatlantic passenger steamers which at present lie at the Tail of the Bank, while passengers are transferred to and from the quay by tenders. No definite decision to proceed with this work has been reached.

Other Ports.

The L.M. and S. Railway Company completed during the year the first section of the improvements at Fleetwood in connection with the fish dock and quays. This railway company also brought into operation the additional accommodation and facilities for the timber trade at Garston docks, on which about £200,000 have been spent. Other works for the benefit of the fishing industry which are now being carried out include, in addition to the works at Grimsby, protection piers at Port Isaac, in Cornwall, the extension of the fishery harbour breakwaters at Staithes, in Yorkshire, and improvements at several of the fishery harbours on the east coast of Scotland. The aerial ropeway and the coal-loading appliances on the eastern arm of Dover Harbour for the shipment of coal from Tilmanstone Colliery, which have been under construction during the year, are nearing completion. The widening of the tidal entrance to the No. 5 basin (Keyham) in H.M. dockyard, Devonport, which was begun in 1925, has been completed. The entrance, which has been enlarged from a width of 95ft. at coping level to 125ft., was actually reopened in 1928, but the removal of some portions of the original return walls under water by divers was not finished until the following year. The enlarged entrance is closed by a sliding caisson. Electrical machinery for hauling the caisson and for raising the deck of the caisson camber has replaced the compressed air machines formerly in use.

The Belfast Harbour Commissioners have decided to build a new basin and quays on the County Antrim side of the river Lagan, opposite Harland and Wolff's works, and to dredge an access channel thereto, at a total estimated cost of £376,000.

Inland Waterways.

Since January 1st, 1929, the union of the Grand Junction, Regent, and Warwick canals under the name of the Grand Union Canal, has been effective. The new company, which controls 240 miles of waterways between London and Birmingham, has already applied for a grant under the Development Act, 1929, to enable it to carry out a large programme of improvements, including the deepening and widening of the waterways, the reconstruction of bridges and the provision of mechanically propelled barges.

One of the proposals for the relief of unemployment which was submitted to the Cabinet Committee on Unemployment, is a scheme for the construction of a ship canal between the Forth and Clyde, the cost of which has been variously estimated at between £40,000,000 and £80,000,000. The Minister of Transport in October appointed a committee, under the chairmanship of Sir Sydney Chapman, to consider the scheme. *The Times*, in a leading article on the appointment of the Committee, not inappropriately described the scheme as venerable, and added that it was "recommended to Queen Anne by Daniel Defoe, but of recent years it has been supposed to be as dead as her late Majesty. The reason is that modern and authoritative surveys have pronounced it to be hopelessly uneconomic." With this expression of opinion we cannot but agree. The appointment of another Committee seems to be an unnecessary method of repeating an answer to a question which need never have been revived.

The Report on British Port Development.

A Committee representative of the Chamber of Shipping, the Association of British Chambers of Commerce, and the Federation of British Industries, issued in mid-December a report on schemes of port development which might, it is suggested, be undertaken with State assistance in order to relieve unemployment. The Committee recommends as urgently required by commerce economically sound schemes of development at Glasgow, Leith, Newcastle, Middlesbrough, Hull, and Swansea. In addition, there are, in the view of the Committee, many small ports now in danger of becoming obsolete, which could recover much of their former traffic and prosperity with comparatively slight expenditure. The suggestion is made that, although it would no longer be economic to improve many of the small ports for use by modern steamships, it might be practicable and profitable to adapt and equip some such ports for use by sea-going motor barges, such as trade regularly between Holland and the Thames. On the subject of port equipment, the Committee states that while the mechanical equipment provided at both large and small ports is, in general, reasonably adequate, considerable improvements could be effected in some cases. Special attention is drawn to the obsolete arrangements for both loading and discharging coal at many of the smaller ports.

EUROPEAN PORTS AND WATERWAYS.

The enlargement of the Joliette Basin at Marseilles and the construction of three jetties within it has been begun. These works are a part of the project for the southern extension of the port which includes the Bassin du Pharo, whose protecting mole, 1½ mile long, will be for the most part founded on the sea bed at a depth of 100ft. The extension of the mole and basin at the northern end of the port is still in progress. The opening of the Rove tunnel in 1927 has given an impetus to the improvement of the remaining links in the Rhone-Marseilles navigation and of the access to the Etang de Berre.

The deep-water landing stage for Transatlantic shipping at Cherbourg is not yet finished. New wharves are being built at Bordeaux and a commencement has been made with the construction of an ocean port for Bordeaux at le Verdon on the southern side of the Gironde entrance. The construction of deep-water quays at Le Havre continues. Considerable attention is being given at this port to the provision of oil import and storage accommodation, which is concentrated on the south side of the tidal harbour.

The first section of the basins at Pantin, a northern suburb of Paris, which are to form the port of Paris, was opened in July. The basin in ½ mile long, 233ft. wide, and communicates with the Seine by means of a canal, 2 miles long. These works constitute a part of the scheme for the development of the Seine navigation, which was approved in 1922.

The new lock at the entrance to the North Sea-Amsterdam Ship Canal at Ymuiden is practically completed, and may be open for traffic before these lines appear in print. With an internal length of 1312ft., a clear width of 164ft., and 46ft. depth of water over its sills at low water of spring tides, it is by far the largest navigation lock in the world, and its cubical capacity is considerably more than double that of the locks on the Panama Canal. The three caisson gates are of the roller type and are hauled into cambers constructed in one wall of the lock. Reinforced concrete has been largely used throughout the work. The side walls rest on reinforced concrete piles and there is a floor of the same material under each caisson sill and camber. In the main lock chamber the natural sand bed is left uncovered between the side walls, the foundations of which are, however, sheet piled.

The death occurred in January of Dr. C. Lily, the engineer who was chiefly responsible for the Zuider Zee reclamation project in its final form, and was Minister of Public Works when the works were approved in 1915. The construction of the main sea dyke of the reclamation is progressing and the navigation locks near the Wieringen end of the dyke are nearly completed.

The question of the Scheldt channels and the improvement of the water communications between the port of Antwerp and the Rhine are occupying a good deal of attention in Belgium. The communications, both with the Rhine and the sea, pass through Dutch territory. On the one hand, Belgium is desirous of the further improvement of the main channel from the sea to Antwerp by the West Scheldt, and on the other hand, proposes the construction of the so-called Moerdijk Canal, which would provide a direct line of communication, protected against bad weather and free from tortuous and dangerous navigation, from Antwerp to the Rhine. For years these matters have been discussed by the respective Governments of Holland and Belgium, but hitherto the opposition of the rival port of Rotterdam appears to have prevented an agreement as to the canal project which would be acceptable to both nations.

The new port of Gdynia, which Poland is creating on the shores of the Baltic, a few miles west of the port of Danzig, is now a place of importance with a population of over 20,000. The Treaty of Versailles gave to Poland special privileges in the Free City of Danzig and its port, but in 1924 Poland began the construction of an entirely new port situated in her corridor to the sea which would, when brought into operation, render her independent of the use of Danzig for carrying on the maritime trade of the country. Port works already covering an area of over two square miles have been made on what was previously the open foreshore and sea bed of the Gulf of Danzig. A series of breakwaters more or less parallel with the shore line and about 2 miles in extent enclose a water area in which over 6000ft. lineal of quayage have been built, a large part of which is already equipped with warehouses, transit sheds and shipping appliances. Large reinforced concrete box caissons which are built on shore, launched and subsequently sunk in position and filled, are employed on a large scale in the construction of the breakwaters and quay walls. Some of these caissons are 106ft. long and have a launching weight of 1200 tons. The works already carried out are only a part of the project which the Government of Poland hope to see completed within the next three years.

In Italy the most noticeable activity in port construction is still to be seen at Genoa, Naples and Bari. At Genoa the new maritime station is being built on one of the new deep-water quays in the old inner harbour. Breakwater extensions are in progress at Naples and Bari, as well as at Genoa. In each case cyclopean block construction is employed, the blocks in some cases weighing over 400 tons each.

The unfortunate rivalry between the great Alsace lateral canal and the scheme for improving navigation on the Rhine itself between Strasburg and Basle still continues. The French are pledged to the former project, the first section of which from Basle to Kembs was begun towards the end of 1927. The Swiss, strongly backed by German interests, have decided to undertake the improvement of the river Rhine itself, but whether this will take the form of canalisation or regularisation, or a combination of both methods, is as yet undetermined. The French will have nothing to do with the river improvement project, which they regard as being in direct competition with the Alsace Canal and, moreover, believe to be redundant as well as of doubtful efficacy. In the meantime during the seasons of low water the traffic on the Rhine between Strasburg and the fine new inland port of Basle falls to almost negligible dimensions.

Work on the old project for canalising the river Moselle between Metz and Thionville, a distance of 18 miles, to which we referred a year ago, was actually begun during the year. The canalised river will provide for the navigation of barges of 350 tons carrying capacity, but the locks will be made large enough to permit of the passage of boats of 1200 tons, if and when the waterway itself should be enlarged. The waterway will serve the Lorraine iron and steel districts.

The experiments with various forms of mechanical haulage on the Rhine-Rhone Canal, which have been made with the object of coping with the increased traffic, have resulted in the decision to employ electric tractors on the section between Strasburg and Huningue. Fifty tractors will be employed; part of the section will be worked on the trolley system and a part with live rail. The speed will not exceed 3¾ miles per hour.

The enlargement of the waterways system connecting the Rhine and Danube, by way of the Main, was commenced by Germany in 1921. The project is to construct a waterway navigable for 1200–1500-ton barges from Aschaffenberg on the Main to Passau on the Danube, a distance of 380 miles. Combined with the navigation improvements is the exploitation of water power. At thirty-eight of the river dams hydro-electric power plants are to be installed. The canalisation of the Main has been begun; one of the four dams in it is in operation and three are in course of construction. From Kelheim to Regensburg, about 15 miles, the Danube has yet to be canalised, but nearly the whole of the 100-mile stretch between Regensburg and Passau has been regulated to give a minimum navigable depth of 6ft., the only dam being one a few miles above Passau just completed. The new canal section connecting the Main with the Danube at Kelheim, which will take the place of the obsolete Ludwig Canal, has not yet been begun.

The prolongations of the training jetties at the Sulina mouth of the Danube, begun in 1922, remain incomplete owing to lack of funds. It will be remembered that this work was undertaken to remedy the deplorable condition of the channel across the Sulina bar, which had supervened on the partial cessation of dredging operations during the war period, and the steady accretion of deltaic material. The direct channel was reopened in 1925 and the subsidiary channels which had been in use for some years were gradually closed during the following year. By the end of 1928 a depth of 25ft. had been temporarily obtained, and since that time the normal depth of 24ft. has been maintained in the channel.

AFRICA.

In South Africa the construction of breakwaters is in progress at Table Bay, Port Elizabeth and Durban. In the case of the first the old rubble-mound breakwater is being extended in the form of an upright wall block-structure; the breakwater at Port Elizabeth is an entirely new structure. The work at Durban is an extension of the existing breakwater, for which a new Titan crane has been erected; block laying began early in the year. New wharves are being provided at Durban, both at Congella and at the oil storage depot. The south arm of the basin at Table Bay is being widened to provide quayage on both sides of it. Work is also proceeding on the new basin works which will, when they are completed, double the available sheltered area.

The first of the deep-water berths alongside the new wharves at Beira was brought into use during the year, and the deepening of the harbour by dredging is in progress. The wharf which had been under construction at Lobito Bay in Portuguese West Africa since 1927 is now in use. The Portuguese section of the railway to the interior was finished, and when the whole of the new line in Belgian territory is open the port of Lobito Bay will, no doubt, be called upon to handle a large volume of traffic.

At Alexandria the Municipality accepted a tender for the construction of a short protecting breakwater in the East harbour, which work will, it is understood,

be commenced early this year. Plans for the development of the larger harbour on the west side of Alexandria, which is controlled by the State, are still under consideration, and no part of the project, which is estimated to cost when completed about £4,000,000, has yet been commenced.

The last published figures of Suez Canal traffic show an increase of nearly 3,000,000 tons over 1927, which was itself a record year. Nearly 32 million tons of shipping passed through the canal in 1928, 56·8 per cent. of the total being British. Among the French ports of northern Africa, Casablanca and Algiers are busily engaged with port works of interest. At the former port wharf construction and the completion of the great breakwater are being carried on, while at Algiers progress is being made with the building of the Mustapha breakwater, begun in 1927, in which cyclopean concrete blocks of over 400 tons weight are used.

THE EAST.

The Singapore naval base has been much in the public eye since the present Government came into power in June. It was thought by some that a radical curtailment of the project would be made, even if the works were not abandoned altogether. Up to the present time, nothing has been done beyond slowing down the progress of certain sections of the work, and it is understood that this will not materially affect the work already in the hands of the contractors, Sir John Jackson, Ltd. The large floating dock for the Singapore base, which was built on the Tyne and towed out in sections to Singapore in 1928, was assembled and completed, and was brought into service on August 14th 1929. The dock, which has a lifting capacity of 50,000 tons, is not much smaller than the great floating dock at Southampton. The Imperial Shipping Committee, of which Sir Harford Mackinder is chairman, issued in June a report on the harbour of Singapore. The Committee's report emphasises the necessity of treating Singapore mainly as a transhipment port. It suggests that any material increases in the port charges which might be brought about by new schemes of extension should be avoided, at any rate for the present. An extension of the deep-water wharves to be carried out in sections is recommended. No change, it suggests, should be made in the coaling arrangements until experience indicates the effect on the demand for bunker coal of the extended use of oil-fuel and pulverised coal. The removal of the Tembaga shoal and reef and the Maender shoal, either in whole or in part, to a depth of 33ft., is recommended as well as the improvement of navigation lights. The Committee considers that no additional dry docks should be constructed at present.

Dredging alone has been relied on to form and maintain a deep channel through the bar which fronts the narrow entrance to a lagoon of great extent and depth at Cochin on the South-west coast of India. No jetties or training banks have been constructed to concentrate or direct the scour of the tidal stream through the entrance due to a rise of about 3ft. at spring tides. In a little over two years nearly 10 million cubic yards of material, chiefly sand, were dredged by suction plant from the bar and the lagoon channel. In one month—December, 1928—1¼ million cubic yards were raised by one dredger, and in one week alone 450,000 cubic yards. A large part of the spoil was pumped ashore for reclamation purposes. This interesting and somewhat bold work was completed in March, 1929, when a minimum depth in the dredged channel of 34ft. at low water springs had been obtained. It is probable that the degree of permanency of the dredged channel cannot yet be estimated with any certainty, but if, as is expected, such a channel can be maintained by periodical dredging on a scale within the economic capacity of the port, the work will be fully justified. In any case, it demonstrates the efficiency of working in an exposed situation of suitably designed suction dredging plant.

Alternative proposals for the construction of harbour works at Tuticorin, estimated to cost £900,000 and £1,140,000 respectively, are being considered by the Madras Government.

The Rangoon Harbour Commissioners are building a reinforced concrete wharf on piles and cylinders at a cost of £350,000. Work was commenced at the end of 1928 and is proceeding. Proposals for an eastward extension of the Sule Pagoda wharves at Rangoon are under consideration.

The construction of the breakwaters which will enclose the new harbour at Haifa, Palestine, has been begun. Quarries for the stone required to form the rubble-mounds are being opened up in the Mount Carmel district, 11 miles from Haifa. The original intention was to carry out the work by contract and tenders were invited over a year ago. It was, however, ultimately decided to dispense with a contractor and to do the work by administration.

The Hong Kong and Whampoa Dock Company has begun the enlargement of its No. 1 dry dock, which will, when the work is completed in about a year's time, then have an internal length of 700ft. and a bottom width of 90ft. It will come as a surprise to most people not closely acquainted with Japan to learn that Tsurumi is the largest industrial harbour in that land. According to a paper presented to the World Engineering Congress at Tokio, which opened in October, harbours and harbour works in the modern sense were not developed in Japan until about 30 years after the opening of the ports to foreign trade. The first harbour construction of modern type was that of Yokohama, completed in 1896, where, it will be remembered, the enormous damage to the works caused by the great earthquake of 1923 was more than made good within the short space of two years. There are now fifty-four harbours in the Japanese Empire properly equipped. Tsurumi, until recent years a fishing village, now incorporated within the city of Yokohama, was developed as a great shipbuilding centre during the late war.

NORTH AND SOUTH AMERICA.

President Hoover in October unveiled a monument commemorating the completion of the great work by which the whole course of the Ohio River, from Pittsburgh to its confluence with the Mississippi at Cairo, Ill., a distance of 968 miles, has been converted into a navigable waterway, with a minimum depth of 9ft. throughout the year. We published a short description of this undertaking in our issue of December 28th, 1928. The canalising of the river on a systematic scale began in 1910. There are fifty locks and weir dams, and the cost of the work has exceeded £21,000,000. The Ohio is a river of very variable flow, ranging from 1600 cusecs to nearly half a million cusecs at Pittsburgh, and from 27,500 cusecs to over 1,500,000 cusecs at Cairo. Before canalisation navigation, even by shallow-draught barges, was impracticable at low stage.

In a speech delivered at Louisville, Kentucky, at the time of the inauguration of the Ohio works, President Hoover outlined a comprehensive programme of additional river improvements to be carried out by the Federal Government within ten years, at an annual expenditure of approximately £4,000,000. The President stated that the Federal Government is already spending £17,000,000 annually on the construction and maintenance of inland waterways. One of the principal projects mentioned by Mr. Hoover is the improvement of the river Mississippi to a depth of 9ft. at low stage from St. Paul to Cairo, and some of its tributaries to 6ft. or 7ft. The total length of navigation to be improved would be over 5000 miles. At the present time the ruling depth in the Mississippi between New Orleans and Cairo is 9ft.; from Cairo to St. Louis, 7½ft.; and from St. Louis to St. Paul, 5ft. The President also foreshadowed a large expenditure on canal and harbour works and measures of flood control on the Lower Mississippi.

The Port of New York Authority is faced with demands for berthing accommodation at piers exceeding 1000ft. in length for the largest type of Transatlantic ship. In November the Authority agreed to acquire the Little Basin on the New Jersey shore, and develop it as a terminal depôt with four piers from 1000ft. to 1200ft. long. Efforts are being made to extend the pier frontage line on a part of the Hudson River front of Manhattan Island, 100ft. into the river, which would enable a number of piers, 1100ft. long, to be built there. At present the pier line limits the length to 1000ft. The decision lies with the War Department which has hitherto strenuously resisted any encroachment on the harbour water area by extending the frontage line riverwards.

The Hudson Bay Railway was opened for passenger traffic to its terminal at Churchill, on the shores of Hudson Bay, in October. The port works at Churchill, authorised in the autumn of 1927, are being pushed on rapidly, and arrangements are being made for grain-handling and shipping appliances to be ready by the time that the quays and dredging work are completed. A considerable area in the naturally sheltered harbour is being deepened to 30ft. at low water of spring tides to provide an access channel to the quays. The construction of a two million-bushel elevator is to be started early in the summer of this year, and it is hoped to bring it into service, together with a portion of the deep-water berths, during the summer of the following year. We published a plan and description of the works in our issue of April 19th last.

The new Welland Ship Canal is rapidly nearing completion. The first vessel to pass through the No. 1 lock was sent upstream on November 1st. The new canal provides seven locks of approximately 46½ft. lift to overcome the total rise of 325ft. between the low-water levels of the two lakes Ontario and Erie. In addition, there is a guard and control lock for regulating the water level in the summit reach at the Lake Erie end of the canal. Three of the locks—Nos. 4, 5, and 6—are in a flight, and in order to avoid traffic delays twin flights side by side are provided. All the other lifts are by single locks. We gave a full description of the locks and lock gates in our issue of May 10th last.

We referred a year ago to the announcement made in June, 1928, that the Canadian Government had decided to establish the Lake Ontario terminus of the enlarged waterway between the St. Lawrence and the Great Lakes, should it be constructed, at Prescott, in Eastern Ontario. A grain elevator is now being built at this place, at a cost of £800,000, which will have a capacity of 5½ million bushels, and a daily intake and loading capacity of 1,000,000 bushels each way. This giant installation, it is stated, will be put into service simultaneously with the opening of the new Welland Canal.

A new scheme for the provision of an enlarged waterway from the St. Lawrence River to Lake Ontario has been submitted by a group of Canadian and American financiers to the Canadian Government. The proposed canals would be in Canadian territory, and the dimensions of waterways and locks would be equivalent to those of the new Welland Canal. The total length of canalisation proposed is about 63 miles. In exchange for the water power rights to be granted to the promoters, they propose to hand over the navigable waterway free of charge to the Canadian Government.

The Montreal Harbour Commissioners have completed a wharf extension, 1000ft. in length. This is a part of an extensive project embracing 3000ft. of quayage for the coal and oil import trade. At Quebec the Harbour Commissioners are busy with the new Wolfe's Cove terminal works begun in 1925. These include an outer breakwater wall with 5000ft. lineal of quayage, transit sheds and three grain elevators, with a capacity of 2,000,000 bushels. The grain storage is now in use, and it is expected that the whole of the works will be completed this year. The new berths have a depth of water of 40ft. at low water.

The additions to the harbour accommodation at Saint John, New Brunswick, which were authorised in 1928, are now being carried out. The works include two 1250ft. piers, each 300ft. wide, a quay wall 1250ft. long, a grain elevator of 1,500,000 bushels capacity, warehouses and transit sheds, and the reclamation of a considerable area of land. The first section of the works, estimated to cost £1,000,000, was commenced in August, 1928, and includes one pier and the grain elevator which are expected to be available for use by the end of this year. The works provide for a depth of 35ft. at extreme low water.

The activity of port development in Canada may be gauged by the fact that the Dominion Parliament in the last session authorised loans to various harbour commissioners, aggregating £6,000,000. This sum includes over 2 millions in each case for Montreal and Vancouver, a million for Halifax, £400,000 for Three Rivers, and a like sum for Chicoutimi, the furthest point on the Saguenay River in the Province of Quebec, that large ocean boats can reach. Vancouver's expenditure on harbour extensions and port equipment during the past eight years has considerably exceeded £1,000,000 annually. Among the new works at present in hand at the port is a new pier in Burrard Inlet, on which over £1,000,000 is to be spent.

A beginning was made with the preliminary work for the construction of a dam at Alhajuela in the Panama Canal Zone to form an additional storage reservoir. A possible shortage of water in dry seasons is foreseen as the result of the rapidly increasing traffic through the Canal. Since 1922 the tonnage of shipping passing through the Canal has more than doubled, and now approximates to that using the Suez Canal, namely, about 32,000,000 tons annually.

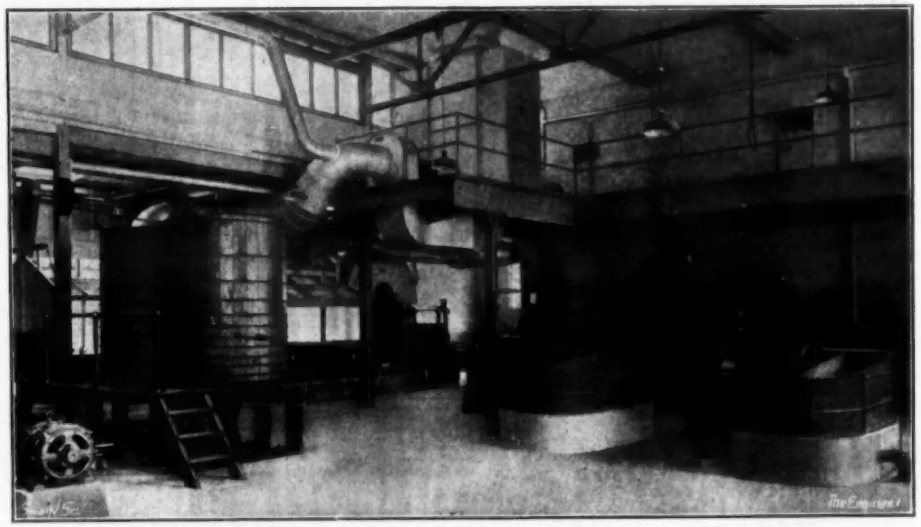
Canadian Pulp and Paper Research Institute.

THERE has recently come into full operation in Montreal what may be regarded as the new and permanent home of the Canadian pulp and paper industry. In it are housed together the previously scattered bodies working for the industry's maintenance and promotion, and to it the many members of the great industrial family dotted over nearly all the provinces from coast to coast can look for aid, advice, and guidance. It is the Pulp and Paper Research Institute of Canada, which has been erected at a cost of half a million dollars among McGill University's notable group of buildings, and it was officially opened by the Canadian Governor-General. The Institute is the first of its kind in Canada to be erected by a trade association, and it is thought probably to be unique the world over in the concentration of scientific forces brought to bear upon a single industry within the confines of one country.

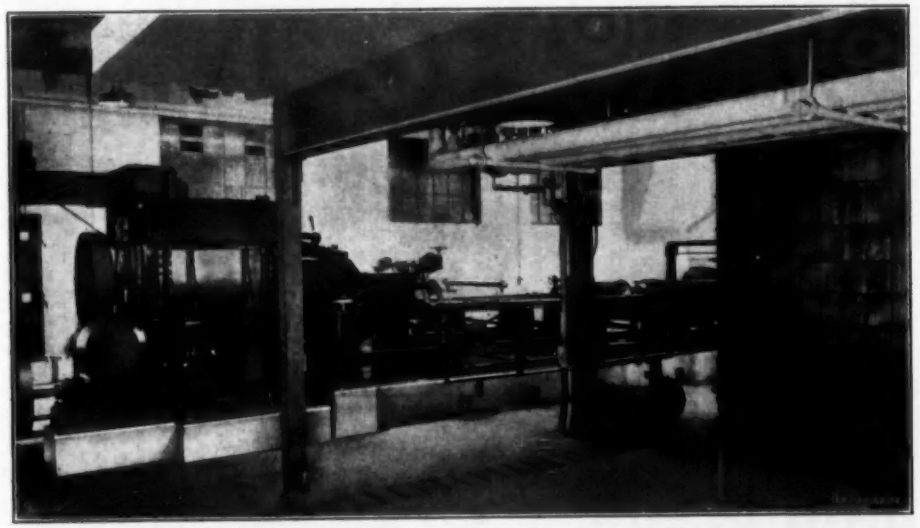
The development of the pulp and paper industry in Canada has been characterised by an attitude and outlook not apparent in the activity in certain other countries. There has been about it from the first an air of permanency, of establishing itself for all time, to send its products abroad in increasing volume and continue making its heavy contribution to the Dominion's favourable trade balance. This attitude rapidly placed Canada among world leaders in the industry, not alone in magnitude of output, but in the nature of the industry's growth, so that from all over the world, in countries much older in the making of pulp and paper, the progress of Canadian manufacture is followed. It is because of a conviction that the industry in the Dominion, though already of huge proportions, will experience further expansion and be of greater national importance in future years, that advance in some direction or other is unceasing. The greatest assurance of the continuance of this advance is given in the new research Institute where manufacturers, a university, and the Dominion Government are co-operating for the furtherance of the industry along the soundest lines.

The Institute is the tangible outcome of several

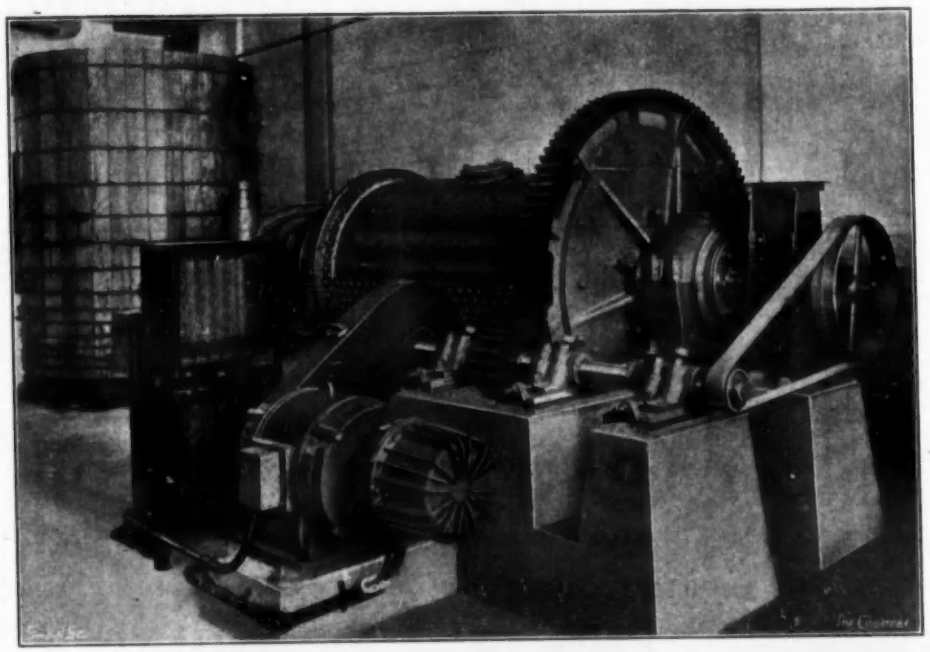
THE CANADIAN PULP AND PAPER RESEARCH INSTITUTE IN MONTREAL



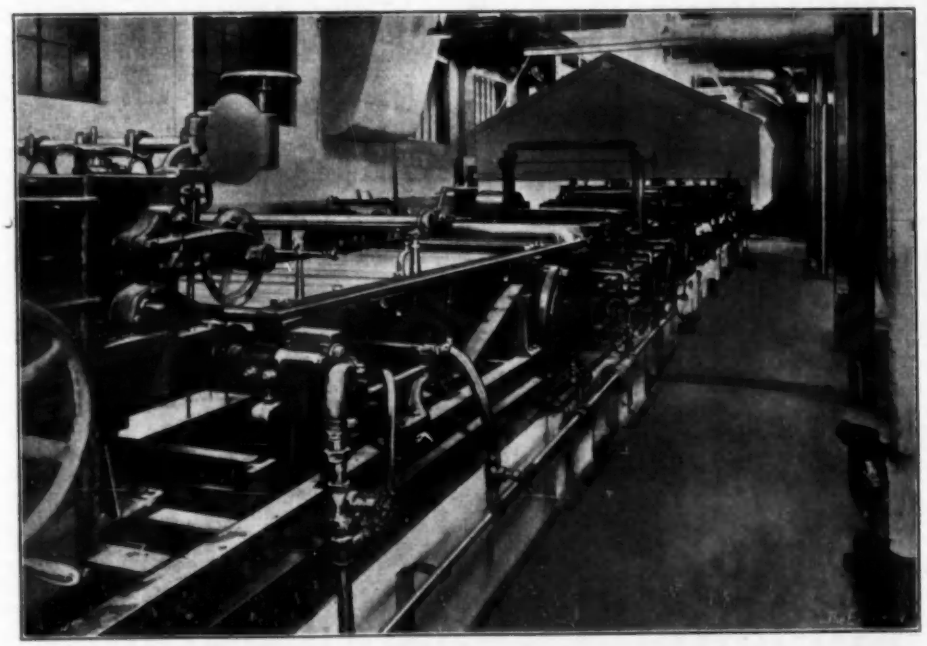
BEATER ROOM, SHOWING DRY END OF PAPER MACHINE AND BINNER ECONOMISER



WET END OF PAPER MACHINE, "BIRD SCREEN" AND VOITER SEWELL INLET



3FT. BY 6FT. MACEY ROD MILL WITH VARIABLE SPEED CONTROL



33IN. EXPERIMENTAL PAPER MACHINE

years of co-operative efforts carried on between the Dominion Government, as represented by the Pulp and Paper Division of the Forest Products Laboratories, and the pulp and paper industry, as represented by the Canadian Pulp and Paper Association. Associated in the Institute and finding a home therein is the Department of Industrial and Cellulose Chemistry of McGill University. In 1920 the technical section of the Pulp and Paper Association reported its dissatisfaction with the rate of progress being made in the investigation of fundamental problems connected with the industry, and a committee on technical research was appointed to consider the establishment of a research department. Following an intensive study of the situation, this committee reported that an understanding had been reached with the Dominion Government, whereby a greater degree of co-operation in the Association and the Department might be secured.

Meantime, a third interest came into being as a result of the establishment of a Chair of Cellulose Chemistry at McGill University, through the beneficence of the late Mrs. E. B. Eddy, whose husband, during his lifetime, was one of the leaders of the industry.

As the building in which the work of the Government Department had been carried on was unsuitable for the proposed joint activities, and neither the Government nor the University was prepared to replace it, the research committee in 1926 proposed the erection of a building specially designed and constructed for the purpose of accommodating the two departments, as well as to provide office accommodation for the Canadian Pulp and Paper Association. This proposal was submitted to members of the Association, who approved the general scheme and agreed to provide the required funds for the erection of the building. Plans were drawn up and approved and construction began in the summer of 1927.

Erected for the definite purpose of pulp and paper research, the building is designed to afford the optimum service and accommodation for this type of work. The first floor of the main building is given over largely to office accommodation, the executive offices of the Association and those of the Division of Pulp and Paper, Forest Products and Laboratories of Canada being situated there. The second floor is largely devoted to accommodation for the Department of Industrial and Cellulose Chemistry of the University.

The third floor represents very similar accommodation to that of the second, save that the large laboratories are occupied jointly by the Department of Industrial and Cellulose Chemistry and the Pulp and Paper Division. The joint laboratories include a physical chemistry laboratory, a colloid laboratory, a photographic room, a nitration room, particularly adapted for work on nitration and cellulose and similar compounds, and a controlled temperature and humidity room. The chemical research staff of the Division of Pulp and Paper is accommodated in a suite of three units of research laboratories on this floor, with an adjoining larger laboratory for special apparatus installation and physico-chemical work.

Under the co-operative scheme of research, the task assigned to the University of McGill is two-fold. In the first place, it is expected to serve as a training ground for research chemists, and chemical engineers destined for important industrial positions; and, in the second, to it is allocated the direction of research and teaching in the field of cellulose chemistry. With the advice and assistance of the other co-operative agencies, an extensive programme of scientific research on the manufacture of sulphite pulp, has been instituted, and considerable progress has already been made. The second unit of the Institute—the Forest Products Laboratories—was established in 1913 as an expansion of the activities of the forestry branch of the Dominion Government. This division has its own laboratories in the Institute and also shares in the use of those provided for joint accommodation.

The Forest Products Laboratories will be a sort of clearing house for ideas in the scientific and technical division of the industry, giving to manufacturers proved scientific facts and tests, and imparting more concrete standards upon which to work. By carefully studying and developing methods it is hoped in time to arrive at a definite standardisation which will be put before the Canadian organisation of manufacturers for consideration of adoption. Foreign co-operation is being enlisted in this work, since the vision from the Institute is broad, and its objective the development of standardised analytic and testing methods for the industry the world over.

One of the most interesting features of the Institute is an experimental paper mill, which occupies its own structure joining the main building. The whole mill building is 125ft. long by 60ft. wide, and is, for the most part, clear of partitions. Since the purpose of the mill is to provide means for making investigations on a scale sufficiently large as to permit a comparison with processes used in the industry, the equipment is all of semi-commercial size. Many of the machines are actual models of commercial units; many others have been specially built to provide the essential features of their commercial big brothers, while at the same time having their capacity reduced enough to correspond with the rest of the equipment. Practically all the operations in the present-day pulp and paper mills may be reproduced; the wood may be chipped and cooked to make sulphite pulp, or it may be ground to produce the cheaper mechanical pulp. Whatever pulp is made, can, in turn, be given appropriate beater treatment and finally be converted into paper on a complete Fourdrinier paper machine, about half the size of the machines which make the bulk of the banknote paper in America.

The Institute also houses control laboratories for making the various tests in connection with semi-commercial investigations. The equipment comprises a chemical laboratory, a dry testing laboratory, a wet testing laboratory, and a dark room for colour testing. In addition to these departments, there is a control humidity room for paper testing. In this room the conditions of temperature and humidity can be controlled at will, so that not only may tests be made under standard-conditions, but they may also be made under conditions which correspond to some encountered in practice, such as excessively dry or excessively damp press rooms and printing plants.

A series of photographs of different departments is reproduced on page 69.

Sanitary Engineering in 1929.

Introduction.

No new development of note in sanitary engineering or sewage disposal has to be recorded as having taken place during the year. The activated sludge method of treatment in its various forms continues to make headway, and seems likely to continue to do so, but beyond that nothing distinctly novel has taken place. A very large amount of sanitary engineering work was, however, in progress throughout the country. At over sixty places there were works either completed or being carried out or about to be begun, the individual costs of which were all in excess of £30,000, while in some cases the expenditure involved ran into hundreds—in some instances, many hundreds—of thousands of pounds. In addition, there was a very much larger number of places with works in hand representing, individually, outlays ranging from £30,000 downwards, and the total cost of all the schemes in progress or in contemplation must amount to many millions of pounds. With some of the more important undertakings we deal, in separate paragraphs, in what follows, but in many other instances we are forced, by considerations of space, to content ourselves with little more than a bare mention.

London Main Drainage.

Abbey Mills Pumping Station: Re-organisation of Beam Engine-house.—The removal of four of the eight beam engines—capacity 60 tons per minute each—which had been in constant use since their erection in 1869, was carried out, and the foundations are being altered to permit of the erection of four electrically driven centrifugal pumps, each with a capacity of 125 tons per minute. Contracts were also entered into for the construction and erection of these pumps and driving machinery. A new culvert for pumping storm water from this engine-house into Abbey Creek is in progress.

Northern Outfall Works, Beckton: Reconstruction of Jetty.—The reconstruction of the pier and jetty at these works was begun in June last. The existing timber jetty, which was erected in 1887, is being replaced by a reinforced concrete jetty on a new line. This jetty, 550ft. long and 16ft. wide, is being constructed of reinforced concrete beams on groups of reinforced concrete piles spaced 42ft. apart, and is designed to carry a light railway and crane, also the pumping mains for pumping the sludge from the outfall works to the sludge vessels, which convey it to the depositing site at the Black Deep at the mouth of the Thames, a distance of about 50 miles. The timber pier is also being reconstructed and widened.

Additional Purification Plant.—A contract was recently entered into for the construction of works of an experimental nature for the treatment, under the activated sludge system, of 5 to 10 million gallons of sewage a day. A number of minor reconstruction and repair works is also being carried out.

Blackpool.

Considerable progress was made during the year with Blackpool's new main sewerage scheme. The new main sewer from Rigby-road to Vicarage-lane, which has a length of 1·1 miles, and comprises a 4ft. 6in. by 4·0 reinforced concrete culvert and 45in. and 36in. diameter concrete pipe, was completed and put into service. An interesting part of this work was the driving in tunnel of a portion of the 45in. diameter sewer under a brick kiln in operation, with a cover of only about 8ft. The 36in. and 48in. storm overflow from Whitegate Drive to Marton Mere was also finished, except for a few hundred feet at the upper end, which it is not intended to carry out at present. The 48in. storm overflow from Harrowside to Hawes Side-lane made good progress, though the section in Burlington-road presented considerable difficulty, since a bed of fine grey silt lies at about invert level, and piled supports had to be employed. New electrically-driven pumping plant was installed at the Manchester-square, Rigby-road, and Bloomfield-road Pumping Stations.

Birmingham.

Improvement to the Rivers Tame and Rea.—The Birmingham Corporation (Rivers Improvement) Act received the Royal Assent on May 10th, 1929. This Act provides for the improvement of the River Tame between Sweetmoor Bridge near Coleshill up to the point where it is joined by the River Rea, and for the improvement of the River Rea from its junction with the Tame up to Bristol-road South, near the South-Western boundary of the City. It also provides for the reconstruction of many bridges necessitated by the widening works and for the reconstruction of the lower length of the Rea Valley Main Sewer. Detail plans are in course of preparation for beginning work on the River Tame early in the New Year.

Hockley Brook Improvement.—The improvement of the Hockley Brook undertaken for the prevention of flooding in densely populated industrial areas of the City, which was begun in 1917, was completed to within a short distance of the North-Western boundary of the City. The total length dealt with is 4·4 miles, in addition to which 1·4 miles of the Main Valley Sewer have been enlarged.

The Tame Valley Sewer.—Further discussions took place between the authorities in the Upper Tame Basin with regard to a joint valley sewer, and alternative schemes were prepared and are at present under consideration by the authorities concerned.

East Birmingham Sewerage.—A joint sewerage scheme has been prepared for the purpose of draining areas on the eastern boundary of the City, which are at present unsewered, together with portions of the adjoining rural districts which lie within the valley of the River Cole, and this scheme is at present under discussion by the authorities concerned.

Sewerage of Perry Barr.—Considerable progress was made during the year with the provision of sewers in the area of Perry Barr, which was incorporated in the City in 1928, approximately £125,000 worth of work having been carried out. A scheme for a further section, estimated to cost £250,000, is in course of preparation, and will be begun in the near future.

Unemployment Relief Works.—The City Council has provisionally approved a heavy programme of work to be undertaken with Government assistance for the relief of unemployment. The programme includes sewerage works to the value of £991,000, and several schemes have already been prepared and submitted to the appropriate Government Departments for their approval, on receipt of which the work will immediately be put in hand.

Bradford.

During the year 6 acres of new filters with water-wheel driven rectangular travelling distributors were brought into operation at the Esholt disposal works, making 31½ acres now in use for the treatment of sewage. In addition, 21½ acres are in various stages of construction. A third line of syphon pipes 48in. in diameter—partly in tunnel—was laid across the Aire Valley, a distance of 725 lineal yards. Each pipe line is capable of conveying 30 million gallons of sewage per twenty-four hours. The pipe lines continue to be successfully kept free from deposits by means of the operation of a solid wooden ball, 3ft. 9in. in diameter and weighing 14 cwt., which is passed through the mains once a week. This system has been continued without intermission since the two original mains were brought into use in May, 1926. The sludge collected in the main precipitation tanks continues to be pressed for the extraction of grease, while the sludge resulting from ordinary precipitation in the storm water tanks is now being dealt with in a sludge digestion plant. The installation of sewage screens was put out of use.

Brighton.

Having regard to weather conditions, the new outfall, the construction of which was begun in 1926 by the contractors—John Gill, Contractors, Ltd.—proceeded satisfactorily, and by the end of the year was within 160ft. of the total length. During the storms of December the heavy gantry which had been completely constructed on the east side of the sewer, was subject to much damage by the wreck of the ss. "Nimbo." The vessel struck the end of the gantry, and entirely demolished about 160ft. in length, and during the continuance of the storm, when the ship was in that position, the wind veered to the south-east, and drove it into the middle part of the gantry, again wrecking a large length. The contractors immediately proceeded with the work of repairing the damage. The Brighton Intercepting and Outfall Sewer Board, on the report of its Engineer—Mr. David Edwards, M. Inst. C.E.—passed a vote of sympathy with the contractors in the damage and difficulties they had experienced, and extended the time of the contract until March, 1931. In connection with this work the Board accepted the tender of the Rees Roturbo Company, Ltd., of Wolverhampton, for the supply and fixing of three electrically-operated centrifugal pumps of the "Non Clog" type, each to deliver 1200 cubic feet per minute. These

pumps will be delivered and fixed early in the New Year. When they are in service there will be a gravitation flow in the sewer from Brighton to Portobello during the period of the rise of the tide up to three times the dry-weather flow.

Burnley.

In our last Annual Article we gave a description of the schemes for the reconstruction of the main outfall sewer and of extensions to and reconstruction of the Duckpits and Wood End sewage disposal works, which Burnley is proposing to carry out. During the intervening period, full drawings and specifications were prepared, and application made to the Ministry of Health for sanction to the necessary borrowing powers. A local inquiry was held, and we understand that the Ministry has intimated its provisional acceptation of the schemes, which remain, substantially, as set out in the article mentioned above, no variation in principle having since been made. It is anticipated that formal sanction will be received at an early date, and that the work will be put in hand early this year.

Chatham and Rochester.

The important joint scheme for the disposal of the sewage of both Chatham and Rochester, which had been in progress for several years, was finally brought to a conclusion by the completion of the low-level sewers and the low-level pumping station. It will be remembered that the sewage from the north side of the River Medway is collected and pumped through a main, which is carried across Rochester road bridge, to the south side of the River where it is delivered into a main concrete sewer, which is owned jointly by Rochester and Chatham. The sewage from the south side of the River is collected and delivered into the same sewer, which conveys the combined flow to disposal works at Rainham, nearly 5 miles away. The cost of the combined scheme, which has been carried out by a Joint Sewerage Board, was in the neighbourhood of £650,000.

Coventry.

During the year active preparations were in progress for carrying out the extensive sewerage and sewage disposal scheme which the City of Coventry has in hand. The scheme may be classified as follows :—(*a*) A new main outfall sewer and storm-water works, the outfall sewer comprising some 4500 yards of egg-shaped sewers, varying in size from 2ft. 6in. by 3ft. 9in. to 5ft. by 7ft. 6in. This sewer will probably be constructed in concrete with a brick invert, and will cost, approximately, £70,000. (*b*) New disposal works at Finham, comprising three screening and detritus tanks; twelve sedimentation tanks, each measuring 120ft. by 30ft.; eighteen circular bacteria beds, each 120ft. in diameter by 6ft. deep; six humus tanks, of the inverted pyramid type, each 32ft. square; sludge and humus pumping stations; 2300 yards of 12in. cast iron rising main to the sludge digestion plant; supply and effluent channels, roads, &c. These works are estimated to cost approximately £136,000; and (*c*) a new sludge digestion plant at Baginton. A 20in. cast iron sludge feed main is to be laid to this plant which will comprise two primary digestion tanks, each 62ft. by 50ft. by 16ft. 6in. deep; twelve secondary digestion tanks, each 40ft. by 20ft. by 14ft. deep; 6 acres of shallow under-drained drying beds, 116ft. by 26ft.; sludge and decanted water pumping plants, pumping and distribution mains, &c. Work on (*c*) was begun in April of last year, and is well advanced, and it is anticipated that the works will be completed and the plant actually put in operation in March or April next. The tanks are being constructed in concrete, with 4½in. brick facing. The total estimated cost of the plant is some £20,000. As regards (*b*)—the Sewage Disposal Works—complete sets of contract drawings we e prepared, and the specification and bills of quantities were compiled and printed. It is anticipated that tenders for the work will be received during this month, and, if the tender provisionally accepted receives the approval of the Ministry of Health, it is hoped that constructional work will be begun in March next.

Doncaster.

During the year the laying of the main intercepting sewer to the Low Pasture outfall works was completed, as was also the construction of the screening house, the detritus tanks, the pumping station, the storm water tanks, &c. These works, which formed Contract No. 9, have been carried out at a cost of £126,000. The pumping machinery, switchgear, &c.—Contract No. 12, £4000—were also got into position at the Low Pasture Pumping Station. The works which were in progress during the past twelve months included extensions to the Sandall Purification Works—Contract No. 13, £55,500—comprising settling tanks, filter beds, humus tanks, sludge lagoons, effluent outfall culvert, &c., and extensions to the Balby Sewage Works—Contract No. 14, £37,300—comprising detritus tanks, screen house, settling tanks, filter beds, humus tanks, sludge lagoons, &c. It is anticipated that the works comprised in Contract No. 13 will be completed early in the present year.

Ipswich.

We announced in our last Annual Article that the Ipswich Town Council had approved the construction of a high-level intercepting sewer and of new disposal works, &c., at an estimated cost of £190,000. During the year, drawings and specifications were prepared, and application made to the Ministry of Health for sanction to borrow the necessary money. With regard to the high-level intercepting sewer, the estimated cost of which is £74,000, the Ministry signified its approval rather more than two months ago, and the work is now well in hand. With regard to the new disposal works, which it is estimated will cost £78,000, and which will include pumping plant for the low-level sewage, screening and detritus removal plants, and continuous-flow sedimentation tanks for the removal of further suspended matters, the scheme is still before the Ministry. As, however, practically all the smaller details have been settled, it is hoped that the whole will be approved at an early date.

Leeds.

In connection with the Thorpe Stapleton sewage disposal scheme of the Leeds Corporation, the construction of the first unit of the sewage purification tanks, feed effluent channels, supernatant water culverts, sludge pumping station at the Low Level Works, was completed. The contract amount for this portion of the undertaking was about £54,000. The construction of the second unit of the sewage settlement tanks—the contract amount for which is about £40,000—was begun and satisfactory progress was made during the year. The total expenditure on the whole disposal scheme up to the end of September last year was £2,106,887.

Leicester.

Good progress was made with the new storm water and sewage disposal works which are being carried out by the City of Leicester. The new electric pumps, which were installed in the extension to the Abbey Pumping Station were in commission during the year, and the new 44in. diameter cast iron rising main was in continual use. The new bacterial works at Beaumont Leys Farm were completed, and put into operation, while the construction of the storm-water tanks at the Abbey Pumping Station was finished, and the tanks now only require soiling down. The detritus tanks, screening chambers, and sludge pumping station were completed, the screening apparatus was erected, the installation of the pumping machinery in the sludge pumping station is being carried out, and an electric crane and grab is in process of erection. Roads and footpaths at the Abbey Pumping Station are now being laid, and it is anticipated that the whole of the new works will be in complete operation early in the year.

Lytham St. Annes.

New disposal works for the Borough of Lytham St. Annes, the Lancashire resort on the estuary of the River Ribble, were put into service in March. The main objects of the new scheme which was then completed, were to remove the positions of the sewers in the St. Annes and Fairhaven areas to a point which would allow the sewage to be discharged without fear of pollution of the foreshore, and to provide for the future development of the combined Borough. The project necessitated (*a*) the abandonment of three outfalls; (*b*) the construction of intercepting and other sewers; (*c*) the building of three pumping stations; (*d*) the construction of storage tanks of a combined capacity of 2,000,000 gallons, in which the sewage may be retained till the ebb sets in in the River; and (*e*) the construction of a new outfall sewer, consisting of 54in. diameter cast iron pipes, which runs in a straight line to the trained channel of the river, a distance of some 1500 yards. The cost of the whole scheme was approximately £375,000.

Manchester.

The extensions at the Davyhulme sewage works made good progress. The overflow and channel to convey the storm water to the old screening chamber was constructed, and it completed the work for the preliminary treatment of the sewage. The plans for the new activated sludge units were almost finished, and work will be commenced shortly. The construction of the effluent culvert and a 9in. cast iron sludge rising main for those units is in hand, the former being a three-ring brick culvert 5ft. 9in. in diameter for part of its length, and 5ft. 6in. diameter concrete tubes surrounded with concrete for the remainder. This work includes a new outlet into the Manchester Ship Canal. The 4ft. 6in. diameter sewer from Waterloo-road to Factory-lane for main drainage work No. 13, described twelve months ago as in course of construction, was completed, the whole length having been constructed under compressed air.

The sewer for the Moss Side and Whalley Range drainage, mentioned in last year's report, varying from 5ft. diameter brick to 18in. pipes, was also completed.

Nottingham.

During the last session of Parliament the Nottingham Corporation promoted a Bill which passed through the various stages practically without any alteration. This Bill was for the granting of powers to the Corporation to carry out additional works at its sewage disposal works, and practically to reconstruct the main drainage system of the city. The work, which is estimated to cost £1,000,000, will be spread over a period of approximately eight to ten years. No time was lost by the Corporation in putting into force the parliamentary powers it obtained, and as the Government is pressing for work to be undertaken for the relief of unemployment, a contract has already been placed with Messrs. Lewis and Beck, Birmingham, for construction of a portion of one of the main sewers in the city. This work is the first instalment of the large scheme, and tenders are now being invited for construction of the outfall sewer, while very shortly other work at the sewage disposal works at Stoke will be taken in hand. The outfall sewer will be approximately 2½ miles in length, and will include a considerable amount of tunnelling.

Sheffield.

During the year the eighteen units of plant on the bio-aeration system for the disposal of sewage were completed and put into operation, so that at the main works a volume of 18 million gallons of sewage per day can be dealt with in dry weather, and an appropriate proportion of storm water. The total cost of these works has been £313,000. At the present time four further units of plant are under construction and good progress was made with the concreting work. The estimated cost of this portion of the undertaking is £84,000. The construction of 12 acres of sludge-drying beds was begun. The beds will consist of specially graded clinker, with sand or fine ash topping. Their estimated cost is £50,000. During the year, too, the sewage works treating the sewage of the Hollinsend District were reconstructed. They comprise Dortmund settling tanks and storm tank, and three spirnkler filters, each 45ft. in diameter. The works, which are now in operation, cost £4400. Two new sprinkler filters were also constructed, and put into operation as an extension of the works at Coisley Hill.

Southend.

Since this time last year a great deal of work has been carried out towards the completion of the Southend Corporation's £275,000 scheme of sewerage and sewage disposal. During the year the principal constructional work was confined to the main outfall conduit from the site of the works at Prittlewell, *viâ* Bournes Green and Thorpe Bay out into the estuary, and no constructional work has yet been undertaken on the tanks and other works which will ultimately be required for the clarification of the sewage and storm water before discharge to the estuary. Nearly 3 miles of the brick-lined effluent conduit, 5ft. in internal diameter, were completed by the contractors, G. Shellabear and Son, Ltd. About 1 mile has been constructed in open cut, and as it is at that part below the hydraulic gradient, it has been heavily reinforced. At one place cast iron segments are being used in tunnel to obviate lengths of standing heading under a main road crossing. Steel sheet piling and short working lengths were adopted in open cut where the main railway line was encountered, the existing bridge foundations having been found to be shallow. The cast iron pipe outfall, 5ft. in internal diameter, also progressed, since the weather during the year was, on the whole, favourable. What is locally known as a "swin," which is a channel in the foreshore, never dry even at low tide of springs, was successfully crossed, and although the available working periods between tides are shorter than they were some time ago, the contractors, Howard Farrow, Ltd., are making fair progress. A length of about 4 miles of cast iron sludge main to the Corporation's sludge lands in the parish of Barling was also finished. This contract, together with sundry small works on the sludge lands, was entrusted to Mr. Jno. Geo. Gray, who has practically completed that work now. The engineers, Messrs. Dodd and Watson, of Birmingham, anticipate being able to advertise a contract for the construction of grit chambers, screens, sedimentation tanks and sludge pumping plant early this year.

Stoke-on-Trent.

During the past twelve months the City of Stoke-on-Trent was engaged on the construction of a disposal plant to deal with the sewage of a portion of its population, at an estimated cost of £186,000. The plant is to consist of sedimentation tanks, followed by partial purification by the diffused air method, with final treatment on 6 acres of bacteria beds. The work is now nearly half finished. Designs have also been prepared for the reception of further sewage from an additional 60,000 population, which will involve an extension of the plant outlined in the foregoing.

Wolverhampton.

The county borough of Wolverhampton, which has a population of 134,000, is the home of the galvanis-

ing, enamelling, and hollow-ware industries, the motor transport and bicycle trades, and lately has become a centre of the artificial silk industry. The dry-weather flow is about 4¼ million gallons per day, and the sewage is of a strong character, with an oxygen absorbed figure—4 hours—of about 20·0 parts per 100,000. The original method of treatment was, in addition to the usual detritus tanks and mechanically cleared bar screens, by the addition of milk of lime, settlement in precipitation tanks, and land filtration. In August, 1927, two units of bio-aeration plant, constructed after the Sheffield model, were brought into use. The aeration tanks are 260ft. long by 112ft. wide, and are divided by thin walls into eighteen channels, 6ft. wide, forming a continuous circuit nearly a mile long in each tank. The working depth is 4ft. and at that depth each tank holds 700,000 gallons. Ten hopper-shaped settlement tanks are provided for continuous settlement of the active sludge, which is either returned to the aeration tanks or sent to drying beds or otherwise disposed of. Two further units were brought into use in July last, and the whole bio-aeration plant now deals with 1¾ million gallons of settled sewage per day, when the average oxygen absorbed figure—4 hours—for the sewage is about 20·0 parts per 100,000. More is treated when the sewage is weaker. A scheme is now in hand for using the bio-aeration plant for flocculation only, and completing the purification on filter beds. The proposed scheme includes new detritus tanks, primary settlement tanks, sludge digestion tanks, storm-water tanks, as well as filter beds, humus tanks, and sludge drying beds.

Works Completed, in Hand or in Contemplation.

Ashford completed and put into service its new sewerage and sewage disposal scheme, which had been in progress for two years, at a cost of £45,000. The West Kent Sewerage Board decided to carry out a sewerage scheme involving an expenditure of over £40,000. Milford Haven proposes to carry out a sewage disposal scheme, at a cost of £40,000. Clacton-on-Sea has in hand sewerage schemes for the town area and for the Bockings-Elm district, of a total estimated cost of £100,000. A scheme embodying the drainage of Thornley, Wheatley Hill, Shotton Colliery, and part of Horden and Blackhall Colliery, was formally opened. It had cost £54,000. Work was begun on the joint Redruth-Illogan joint sewerage scheme. It is to cost £100,000, and will embody a main trunk sewer, 4142 yards long, a main tributary sewer 3297 yards long, and a number of branch sewers. A Ministry of Health inquiry was held regarding a sewerage scheme, promoted by the Southampton Borough Council, which is estimated to cost £190,000. At Exeter an inquiry was held in connection with an application to borrow £100,000 for the reconstruction of the city's sewerage. Still another inquiry was held at Stapleford, which is proposing to carry out a new disposal scheme, at a cost of £36,650. The Truro Town Council approved of a disposal scheme to cost £60,000. Surbiton is contemplating an extension of its disposal works at a cost of £30,000. Shoreham has in hand a new sewerage scheme which is estimated to cost £45,000. Grimsby decided to carry out a sewerage scheme for Scarthoe, at an estimated cost of £41,250. Romford has decided to construct a new outfall sewer and auxiliary works at its sewage farm at a cost of £134,000. Hitchin has approved a scheme for providing additions to and improvements at its disposal works which will involve an expenditure of £37,000. Stafford put into service a new disposal plant, which has been installed at a cost of £27,000. It operates on the diffused air activated sludge system. The Sunderland Corporation approved a scheme of sewerage reconstruction which is to cost nearly £100,000. Carlisle had under consideration a scheme for constructing sewers and other works, the estimated cost of which is £36,000.

Wembley is considering a scheme for sewerage and storm water drainage, which would entail an expenditure of £145,000. Belfast is promoting a Bill in the Northern Ireland Parliament seeking powers for carrying out a sewerage scheme at a cost of some £100,000. Watford has been engaged on a sewerage scheme which involves the driving of a tunnel sewer under the town. Romsey decided to improve the drainage of the town at an estimated cost of between £25,000 and £30,000. Airdrie opened new works which operate on the "Simplex" surface aeration system. A small bio-aeration treatment scheme is in progress at Swinton, Yorks. Chertsey has in hand a drainage scheme which is to cost some £67,000. Wokingham has decided to construct a sewage disposal works at an estimated cost of £54,000. Derby is concerned with the extension of its sewage disposal works, and is applying for parliamentary powers in connection with the River Derwent Improvement Scheme. The Joint Scheme for Ilford and Barking sewerage received the sanction of the Ministry of Health. By it, it is proposed to convey the sewage to the London County Council's outfall works at Beckton, and the works comprise the laying of trunk and subsidiary sewers, the construction of storm water tanks, and a pumping station, the laying of a pumping main and the driving of a tunnel under Barking Creek. The scheme is expected to cost £180,000. The Richmond Main Sewerage Board was engaged during the year on the extension of its engine-room, the construction of a new pumping plant, and the installation of two 120 B.H.P. Diesel engines driving vertical-spindle centrifugal pumps, each having a capacity of 10 million gallons per day. The work is nearing completion. It has also had under consideration the diversion of a 27in. diameter sewer, by means of concrete tubes in tunnel, this work being necessitated by the proposed construction of a new bridge at Chiswick. A Ministry of Health inquiry was held into the proposed sewerage and sewage disposal works at Wednesfield, at a cost of £34,000. Work was begun on a £60,000 sewerage scheme which is being carried out by the Thanet Rural District Council. Operations have been and still are in progress in connection with a sewerage and sewage disposal scheme for Blandford, Dorset, at a cost of £24,000. Blackburn decided, subject to official approval, to carry out sewerage and other works in connection therewith, at an estimated cost of £140,000. The Ham (Surrey) Urban District Council has in hand a scheme for the reconstruction of its sewage disposal works and the provision of a new heavy oil engine driven pumping plant. The works in connection with the drainage of the Ickenham, Hillingdon, and Harefield districts, on which the Uxbridge Rural District Council has been engaged for some time past, were continued through the year, and are now nearing completion. The full scheme, which included the running of long sewers and the construction of two pumping stations and disposal works, involved an expenditure of some £120,000.

Applications for Loans.

In addition to the foregoing, sanctions for incurring loans were either applied for by, or granted to, the following places, the amounts involved being in each case added in brackets:—S. Mimms (£39,500); Gravesend (£33,500); Ringwood (£20,000); Little Hulton (£25,180); Oldham (£38,000); Isle of Thanet, for Birchington (£75,000); Kilkenny (£25,000); Epsom Rural District Council, for Ewell (£24,573); Portadown (£46,700); Chertsey (£67,000); Wokingham (£54,000); Dudley (£41,500); Rayleigh (£63,882); South Shields (£53,000); Acton (£32,000); Maidstone (£29,400); Havant, for South Hayling (£47,614); Derby (£41,500); Marlow (£46,302); Shoreham (£45,000); Romsey (£30,000); Sutton and Cheam (£25,000); Haslemere (£34,315); Rochford, for Hawkwell (£48,488); Chester-le-Street (£45,000); Rhyll (£65,000); Clacton-on-Sea (£73,200); Wednesfield (£34,000); Staines, for Hanworth (£21,567); Uxbridge (£45,000); Salford (£56,750); Preston (£85,000); Shoeburyness (£27,741); Portsmouth (£121,500); Worthing (£44,004); Bermondsey (£45,141); Billericay (£49,900); Gravesend (£42,000); Caterham (£29,500); Hove (£60,800).

The Pollution of River Research.

On the recommendation of its Water Pollution Research Board, the Department of Scientific and Industrial Research decided to make, in co-operation with the Tees Conservancy Commission, a thorough biological and chemical survey of the river Tees. The object of the survey was to gain scientific knowledge as to the natural behaviour of a river flowing through an industrial area. Endeavours are to be made to find out how the river counteracts the effects of pollution; to determine its capacity for self-purification; and to ascertain, generally, the conditions which may help or hinder the natural process through which purification is effected.

Paris.

The opposition to the laying out of new sewage farms impeded work by the Paris Municipality during the year, and it is obvious that little can be done until it is known definitely whether the attempt to secure the suppression of sewage farms will succeed. Now that the sewage arrangements in the suburbs covering the Department of the Seine are to be incorporated in the Paris system, the claim that it is necessary to extend farms in order to carry out the existing programme may render the opposition ineffectual. A Bill was introduced into Parliament for the suppression of sewage farms, but the Government can always authorise an undertaking on the ground of public utility. The programme sanctioned by the Prefect of the Seine provides for the construction of a collector main from Issy with two branches, one going to the Place de la Concorde for the collection of practically all the sewage on the south side of the river, and the other to the Porte d'Italie, where it will receive the sewage from the southern suburbs. This will be carried by a main which will be laid from the Pont de l'Alma to La Frette, a town on the Seine opposite the Achères sewage farm, and a pumping station will be installed there for sending the sewage across the river to the new farms, which it is proposed to lay out and which are meeting with strong local opposition. Another collector will be constructed between Clichy and Charenton for the sewage from the suburbs on the east and north-east of the city. After decantation, this will be discharged, as at present, partly into the Seine at Saint-Denis and partly to the sewage farm at Gennevilliers. These works are intended to suppress entirely the discharge of used water and sewage into the Marne and the Seine in and above Paris. The total cost of the undertaking is estimated at 2500 million francs, more than one-half of which will be devoted to the construction of a works for decanting and treating sewage. The carrying out of this enterprise, which will completely reform the present system of sewage collection, will occupy about twenty years. While farms are regarded as indispensable for such a vast scheme of sewage disposal, experimental plants continue in operation for the bacterial, activated sludge, and other methods of treatment. This unifying of the sanitary arrangements in the Department of the Seine has brought the Prefect of the Seine into conflict with some of the suburban towns, which object to the expense of putting down incineration plants for house refuse. Here, again, all available methods of treating house refuse are being investigated, but so far nothing has been found more satisfactory than the burning of refuse and utilising the energy and by-products.

The Physical and Optical Societies' Exhibition.

No. II.*

By means of the Cambridge recording colorimeter—shown in Fig. 10—it is possible to take relative measurements of the colours of two solutions or to compare the colour of a solution with that of a standard solution. Two beams of light from the opposite sides of the straight filament of an electric lamp are directed by optical systems through similar paths, and an image of the transmitted beam is focussed on to a photo-electric cell. In the path of one of the beams a vessel containing the solution under test is placed, while in the path of the other beam is a vessel containing either a standard solution or the solution to be used for comparison purposes. The photo-electric cell is connected through an amplifying system consisting

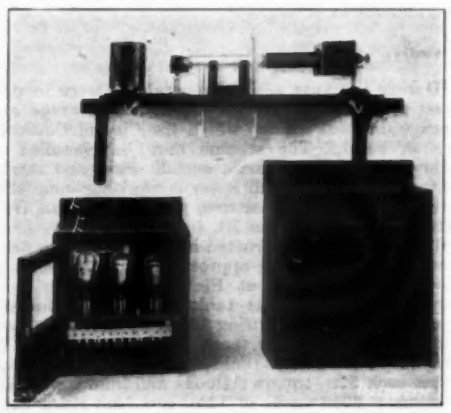


FIG. 10—RECORDING COLORIMETER—CAMBRIDGE

of thermionic valves, &c., to a standard thread recorder. When the solutions are of exactly the same colour the recorder will trace a record on the centre of the chart. When the solution which is under test varies in density from the comparison solution, the corresponding record will be either to the right or to the left of the zero line, depending on whether the solution is darker or lighter in colour than the standard one. The equipment can be operated either from direct current or alternating current, but an alternating-current supply is preferable. The vessels containing the solutions to be compared consist of a glass tube, about 25 mm. in diameter and 150 mm. long, with plain glass end pieces, cemented in position. The equipment, which is made by the Cambridge Instrument Company, is being used on a strong caustic solution containing a slight amount of copper. Three Osram valves are used to amplify the current from the photo-electric cell, and the valve circuit is operated from the alternating-current mains through a transformer, a patented device being incorporated to nullify the effect of voltage fluctuations.

Among the exhibits of Marconi's Wireless Telegraph Company, Ltd., of Marconi House, Strand, London, W.C. 2, was an aircraft direction finder, with a stream-lined frame aerial designed to enable an operator on an aircraft to determine his position by taking bearings on known ground stations or beacon stations. In the design of this instrument great attention has been paid to four points—space, weight, screening and simplicity of operation. The receiver is designed for a wave range of from 600 m. to 1600 m., thus covering the standard wave-lengths used by ships and aircraft. The stream-lined frame aerial has been designed to enable the loops to be supported in a rigid position as far as convenient from the body of the machine with the minimum air resistance. From the wireless standpoint the aerials should embrace as large an area as possible, but in practice the air resistance imposes severe limits on the area and, therefore, the efficiency of the

* No. I. appeared January 10th.

aerials. The high degree of amplification, however, compensates for any loss of efficiency due to the restricted area of the aerial loops. There was also an aircraft receiver designed to meet the needs of those requiring a short-wave receiver for the interception of telegraph and telephone signals and suitable for use in any type of aircraft or vehicle, and in land stations. There are only two adjustments, namely, tuning and reaction, and the instrument covers a wave range of from 15 m. to 150 m. Three valves are used in the receiver, the first being a high-frequency amplifier of the screened-grid type. Another interesting exhibit was the Marconi sounding device, which is manufactured in accordance with the Langevin-Florisson Chilowsky patent, and transmits waves of high-frequency oscillations from the bottom of a ship to the bottom of the sea, receives the waves reflected back like an echo, and measures the time between the transmission and the reception of the reflected wave. As the rate at which a disturbance travels through sea water is well known, the instrument which measures the time between the transmission and the return of the impulses can be graduated in fathoms. When the apparatus is switched on it commences to operate automatically at 15 sec. intervals, the pointer moving to the figure indicating the depth of water and remaining at that position for about 10 sec. A tell-tale is provided to show whether or not the moving parts of the instrument are working at the correct speed. The instrument is provided with a hand adjustment for the draught of the vessel, so that the position of the pointer shows the actual depth of water as measured from the surface.

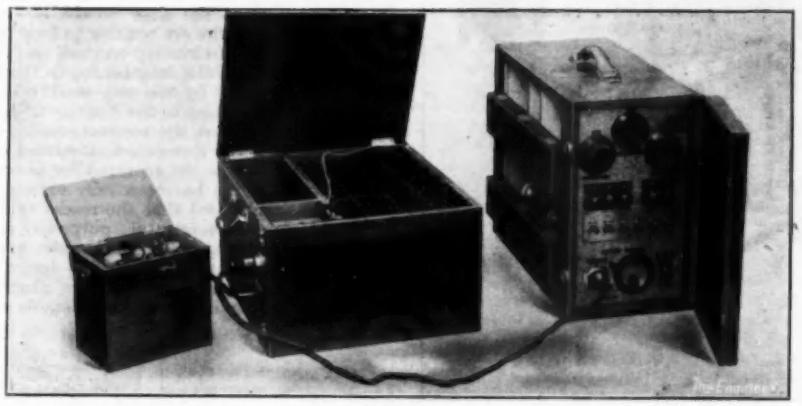


FIG. 11—TONE GENERATOR—MARCONI

The Marconi tone generator shown in Fig. 11 delivers a pure sine wave of voltage over a frequency range variable between 20 and 10,000 cycles, with the amplitude of the output remaining constant, and can be used for tests and measurements when a steady supply of pure tone frequency is essential. In its development as a testing instrument, various applications suggested themselves, principally the testing of intervalve low-frequency transformers, telephone earpieces and transformers, loud speakers, and the modulation constancy of wireless telephone transmitters. It is also of use in measurements of capacity, inductance and power factor. The tone generator contains two high-frequency oscillators, one operating at a fixed frequency and the other variable. The output from them is taken to a detector circuit and the resultant beat, which is variable between 20 and 10,000 cycles, is amplified into a power output of 26 milliwatts. A fine control of the output power to the circuit under test is provided. When used in conjunction with the Marconi valve voltmeter it forms a reliable means of measuring the gain of low-frequency amplifiers, and the loss in low-frequency filters; it may also be used for the measurement of attenuation of land lines and filters. There are, no doubt, many other uses for this equipment which will appeal to those requiring a constant supply of pure tones.

One of the most interesting exhibits of Everett, Edgcumbe and Co., Ltd., of Colindale Works, Hendon, was a master frequency meter. In all up-to-date power-houses it is essential for the frequency to be rigidly maintained at its normal value. In the Everett-Edgcumbe master frequency meter the speed of revolution of a small synchronous motor is continuously compared with the time-keeping of a master clock, and in this way the mean frequency is controlled. At the exhibition the system was given a very practical test, for one of these master frequency meters was installed, in conjunction with the rotary converter which supplied the alternating current used on the stands. This load is necessarily a very variable one, and at last year's exhibition, considerable trouble was experienced by exhibitors owing to the unsteady frequency, and its proper regulation this year was much appreciated. With the introduction of the master frequency meter, which enables the mean frequency to be maintained within the equivalent of a few seconds per day, it becomes essential to install a really accurate graphic frequency meter, in order to ensure that the frequency has been properly maintained throughout the 24 hours, and not merely corrected at intervals. To secure the desired accuracy Everett, Edgcumbe and Co. have developed an instrument based upon an entirely novel principle. A continuously-running synchronous motor is geared on to the inking arm of an inkwell grapher, for a period of 2 minutes at a time and then released again. During the time that it is geared to the inking arm, the latter is carried forward across the chart, thus tracing a line with a length proportional to the number of revolutions made by the motor in a given time, and therefore to the frequency. At the end of each period the pen drops back, and the result is a series of parallel lines, the terminal points of which accurately represent the frequency. The scale can be "set-up" to any desired extent; in fact, a full deflection on either side of the normal frequency can be obtained with a difference of only 1 cycle. The advantage of this instrument is that the indication depends solely on the number of alternations of the current and upon the time. The indications are entirely independent of wave-form, voltage, temperature, &c., whilst the time intervals depend upon the time-keeping of a clock which is accurate to a very small fraction of 1 per cent., the overall accuracy being, in fact, about 0·1 per cent.

An interesting frequencygraph was exhibited by Instrumenti di Misura C.G.C., of Monza, Italy. The torque and sensitivity of this instrument are said to be considerable, and the scale is spread out so that

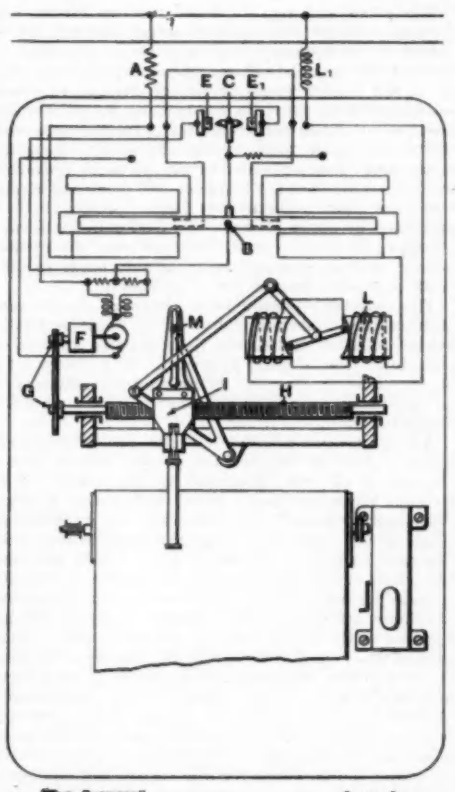
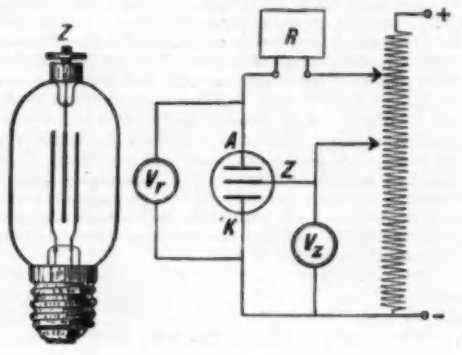


FIG. 12—FREQUENCYGRAPH—INST. DI MISURA. C.G.C

two cycles occupy a width of 6in. Very small variations in the frequency are therefore easily detected, measured and recorded. As shown in Fig. 12, a form of Kelvin balanced arm is balanced at the point B and carries a contact arm C free to close an auxiliary circuit either at E or E^1. One circuit of the coils operating this arm consists mainly of an ohmic resistance A, the other is made up chiefly of a fixed inductance L^1 and a variable inductance L. Both are connected in parallel with the line and the coils are arranged to give a balance at a given frequency. In the event of the equilibrium being upset, however the contact arm C will close one of the circuits and the motor F will be put into operation, and through gearing G an endless screw H and block I—carrying a pen and pointer—will readjust the inductance L and therefore re-establish the equilibrium of the balance arm. The instrument shown was designed for a 110-volt, 50-cycle system, and with a scale arranged for the interval of 49–51 cycles with equal divisions. The contact system is designed to allow of easy inspection and both contacts can be taken out and replaced in their proper position in a few seconds. An effective spark absorbing device ensures that the contacts only need cleaning at very long intervals. The instrument is said to be independent of voltage variations up to 20 per cent. and is not influenced by wave form or temperature changes. The chart, which is 120ft. long, is of the straight co-ordinate type and is driven by an eight-day clock having a change-over lever giving two speeds. The chart is timed so as to correspond to millimetres per minute and any speed from 15 mm. to 300 mm. per hour can be selected. The ink is supplied to the paper through a sharp steel-bladed drawing pen fed from a totally enclosed ink holder, and ink refilling is only necessary about every three weeks.

Among the exhibits of Isenthal and Co., Ltd., of Duncan Works, Victoria-road, North Acton, was a very sensitive glow relay for laboratory and industrial purposes. The special advantages claimed for it are minimum primary current, large secondary current, energy consumption nil when working below the critical voltage, freedom from inertia, absence of mechanical parts insensitive to vibration and moderate first cost. The relay operates definitely



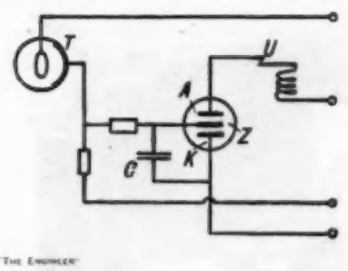


FIG. 13—GLOW RELAY AND CONNECTIONS—ISENTHAL

with an impulse current of only 10^{-10} ampères, and when discharging passes as much as 30 to 40 milliampères, so that the amplification obtained when using a mechanical relay in conjunction with it is very great indeed. The advantages of the relay are very pronounced when minute electrical effects have to be recorded, and which would be altogether too small to work any type of mechanical apparatus. In combination with highly sensitive photo-electric cells, the glow relay will operate with minute variations of light intensity. When actual movements have to be recorded it is generally possible to secure the desired result by directing a ray of light by means of mirrors and diaphragms on a photo-electric cell, which in turn will influence the glow relay. With the aid of the photo-electric cell and glow relay all kinds of automatic controls and supervisions become practicable. As shown in the upper left-hand drawing—Fig. 13—the glow relay contains three electrodes, an anode and a cathode, at one end of the bulb and a control electrode, which is introduced at Z at the opposite end of the bulb. The usual circuit employed for demonstrating the action of the apparatus is shown in the upper right-hand diagram, where it will be seen that the relay voltage Vr and the control voltage of the electrode Z may be varied. When the electrode Z is disconnected and the voltage Vr is gradually increased, a value is reached at which the glow discharge suddenly sets in. In practice, the pressure Vr is kept at about 5 to 20 volts below this "threshold voltage," and an increase of the control voltage Vz to the "spill over" voltage will bring about the glow discharge between the outer electrodes. The value of the "spill over" voltage is usually in the neighbourhood of 180. In the "expectant"

stage both the relay voltage and control voltage are maintained below the critical value and the discharge is released merely by raising the control voltage above the critical value. It is, therefore necessary to connect the glow relay so that the current to be made manifest increases the voltage at the control electrode. The intensity of the resulting relay current, which varies from 20 to 40 milliampères, is sufficient to work an ordinary mechanical relay R, but since, after the "spilling over," the glow discharge does not spontaneously discontinue, the mechanical relay R is designed so that it automatically opens the discharge circuit. The extreme sensitivity of the glow relay can be demonstrated by connecting it up as shown in the diagram, but leaving the control electrode Z isolated. The act of touching the electrode Z is sufficient to impart to it a weak positive charge which starts the glow discharge. Even the approach of a flame to within a few centimetres of the electrode Z causes "spilling over" as a consequence of ionisation of the air near the electrode Z. The relay is shown in combination with a photo-electric cell in the lower diagram. Illumination of the cell T will result in the charging up of the condenser C, until the potential of the middle electrode Z has reached the "spill over" voltage, and at this moment the mechanical relay U operates a signal and also interrupts the circuit through A and K, the resistance in the photo-cell circuit being sufficiently high to cause the trigger circuit to interrupt automatically. With the aid of these relays all kinds of ionisation phenomena, &c., may be recorded, and a great many technical applications may be evolved.

A magnetically-operated mercury vapour relay was shown by the Research Laboratories of the Gramophone Company, Ltd., and the Marconiphone Company, Ltd. A mercury vapour tube with a heated filament has been developed in which the conductivity can be greatly increased when a magnetic field is applied in a direction parallel to the filament. Over a certain range this increase is proportional to the strength of the magnetic field and can, therefore, be continuously varied. Visitors were enabled to control the relay by a permanent magnet held in the hand. Another exhibit showed a practical application of the relay. A pendulum was kept swinging at its own free period by means of a permanent magnet attached to the extremity of the pendulum, which, as it passed over the relay tube, permitted a current impulse to pass, and this impulse was utilised to keep the pendulum in motion.

Two continuous process electric furnaces with automatic heat regulation were shown in operation by R. M. Catterson Smith, 429B, King's-road, Chelsea, London, S.W.—a twin-tube furnace (Fig. 14)

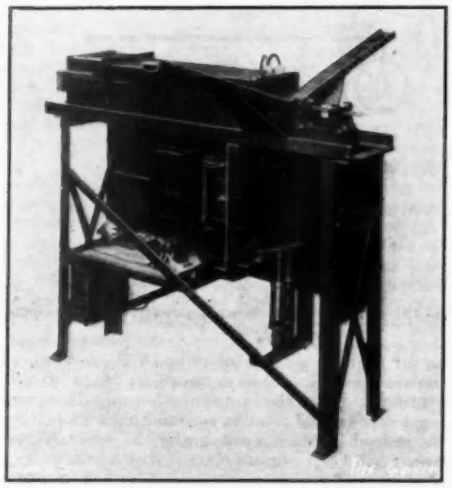


FIG. 14—TWIN-TUBE FURNACE—CATTERSON SMITH

and a rotary furnace (Fig. 15). The twin-tube furnace is for heating and automatically delivering brass billets for hot press brass work, and it handles round billets $\frac{5}{8}$in. diameter up to 2in. long with an output of eight per minute at a temperature of 800 deg. Cent. The billets are placed in hoppers from the bottom of which they are pushed one at a time at regular intervals alternately into twin Staybrite steel removable liners, each billet pushing forward those already in the liner. The liners pass through nickel chrome wound heater tubes 20in. long and through a final heating chamber 7in. long heated by "Silit" rods. As they pass through the liner the billets are progressively heated and are ejected at about 800 deg. Cent. sliding down channels to a convenient position for seizing by tongs. A constant temperature at the delivery end is maintained by an automatic control actuating a clapper switch in the main circuit. The feed mechanism consists of rods mounted between rollers in line with the furnace tubes and actuated by solenoids below the furnace. Adjustable oil dashpots are fitted to the solenoid gear. The rate of feed is timed by mercury switches in the solenoid circuits mounted on a cam shaft rotated by a small motor and reduction gear. The speed of rotation can be altered by a sliding resistance in the motor circuit. The furnace is an independent unit which can readily be disconnected and removed. A hinged lid carrying the top heat insulation allows for removal and replacement of the nickel chrome heater tubes. About 70 per cent. of the total input is absorbed in heating the billets, and the maximum consumption of the furnace is 3·2 kW.

The small rotary furnace—shown in Fig. 15—demonstrates the advantages of a continuous moving hearth totally enclosed throughout its movement. The furnace is in the form of an annular steel casing enclosing refractory insulation surrounding a chamber

FIG. 15—ROTARY FURNACE—CATTERSON SMITH

with a working space of 4in. wide by 2in. high and a mean length of 6ft. The bottom of the chamber consists of a ring of sillimanite, forming the rotary hearth, which is keyed into a lower ring of refractory insulation slotted on its under side to receive a ring of non-scaling steel which runs on three rotary supports. These supports are rotated at the desired speed by a $\frac{1}{4}$ H.P. motor and reduction gear, the speed being varied at will by movement of a resistance in the motor circuit.

The main heating is carried out by fifteen non-metallic resistor rods placed across the top of the chamber, preliminary heating being provided for the first 120 deg. of the circumference from the feed-in by a top heater panel of nickel chrome resistance winding, which provides for heating up to 750 deg. Cent., after which the articles being treated pass under the main heater rods, which are carried in special sillimanite refractory carriers and are easily removable from the outside of the furnace. All electrical connections are made outside the furnace casing and are protected by cover plates. The feed is in the form of a hopper in the top of the furnace over the rotating hearth, and is arranged at a suitable angle to allow small tools, &c., to slide on to the hearth.

The delivery opening is at the side, and a ramp of refractory material placed at an angle across the line of rotation causes the heated tools to slide out and down the sloping aperture. The temperature at the delivery opening is maintained constant by an automatic expansion thermostat operating a D.P. clapper switch.

An important advance in the art of rupturing highly inductive high-tension power circuits without the use of oil was illustrated by an exhibit of the British Electrical and Allied Industries Research Association, which was showing a double-break single-phase unit of an experimental switch model designed to rupture 25,000 ampères at 11,000 volts, the whole of the arc rupturing process being arranged to take place within an inner contact chamber having a volume not much greater than that of an ordinary tumbler switch. The model, the arc rupturing contact of which is shown in Fig. 16, has been subjected to severe tests, including the rupturing of over 10,000 ampères at low-tension and several thousand ampères at 5500 volts per break, the rupture always occurring within one cycle, *i.e.*, approximately 0·02 of a second from the commencement of arcing. During the time of arcing the gap between the separating contacts is limited by a stop to approximately $\frac{3}{4}$in. and is traversed by a blast of air moving with a velocity in the neighbourhood of 1000 miles per hour for the brief period during which the rupture takes place. The arc rupture contact chamber *c* is mounted in a gas-tight enclosure shown by the dotted lines *a* and the vent opening *d* is closed by a mushroom valve capable of giving a sudden wide opening on the tripping of a toggle. In the closed position the moving contact *e* is pushed tightly into the contact passage *d*, which is composed of segments fitting closely together and held in contact by a bracelet spring. The mushroom valve is also closed and the air pressure in the chamber *a* is raised to the required value of one or two atmospheres by connection with a compressed air system. In this position the current enters *viâ* the fixed contact and flows out *viâ* the moving contact *e* and its stem *f*. To open the breaker and rupture the arc the contact *e* is rapidly withdrawn, and as it leaves the passage the toggle on the mushroom valve is tripped. As soon as the contact *e* is clear of the walls of the passage *d* a powerful blast of air flows through the annular opening between the insulating plate *g* and the contact *e* and thence round the arc into and through the passage *d*, thus driving all the arc gases and filling the gap with gas of high dielectric strength when the current reaches zero in its alternation. To achieve this result the arcing chamber *c* is so designed in relation to the movement of the contact *e* that the arc cannot escape sideways from the blast of air entering the passage *d*, as it might normally tend to do by magnetic looping in the absence of guiding means such as *c*. Moreover, lengthening of the arc at maximum current—when its output of ionising vapour and its destructive power are greatest—is reduced to a minimum in the axial direction of the contact *e* by so dimensioning the passage *d* that at maximum current the close proximity of the walls force any part of the arc tending to loop up into the passage to be short-circuited on itself and thus return to the entrance, whilst lengthening in the downward direction is limited by the very small travel allowed to the contact *e*, which in the diagram is shown in the full open position at the commencement of the arc rupture. A further downward movement of the contact *e* can, however, be arranged for insulating purposes after the arc has been fully extinguished. It should be emphasised that the model exhibited was designed for experimental purposes with large clearances allowing of considerable experimental adjustment, so that apart from the design of the arc rupturing chamber shown in the diagram which approximates the final form, considerable economy in

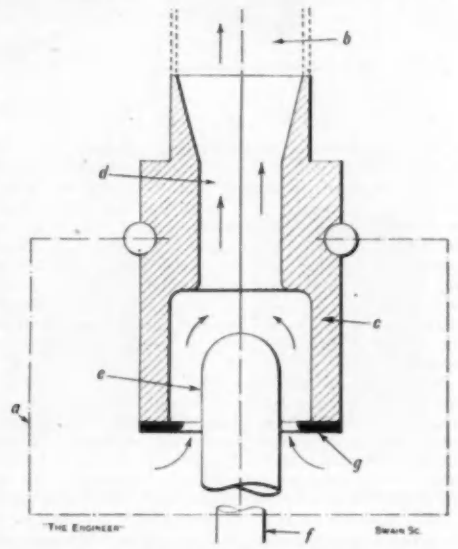


FIG. 16—ARC-RUPTURING CHAMBER B.E. & A.I. RESEARCH ASSOCIATION

space will no doubt be made in the later stages of commercial development of the mechanism and of the air storage parts of the apparatus. The exhibit included two specimens of contacts such as that shown at *e*, but of smaller size. One of them, which was only $\frac{3}{8}$in. in diameter, showed slight burns on the top, but whilst this contact had actually cleared three short circuits in succession, each of approximately 2000 r.m.s. ampères at 5500 volts, the bearing surface was not damaged. The other contact with a diameter of $\frac{3}{4}$in. had operated some forty times in succession on heavy short circuits without damage to its bearing surface. Both contacts were exhibited in the state in which they had been taken from the breaker. We understand that this breaker, which was described in a paper entitled "An Introduction to Researches on Circuit Breaking" in the Institution of Electrical Engineers' *Journal*, May, 1929, for which Messrs. Wedmore, Whitney and Bruce were awarded the Kelvin premium, has been evolved as the result of several years' research by the E.R.A. at Carville on behalf of British switchgear manufacturers, and that it represents only one of several exceedingly promising methods of arc rupturing which have been devised as the result of these researches. Further particulars of these researches are to be found in the I.E.E. paper mentioned.

Griffin and Tallock, Ltd., of Kemble-street, W.C. 2, were exhibiting an apparatus designed by Mr. W. S. Welander for timing falling bodies and by means of which "g" may be determined within one-tenth per cent. for a fall of 100in., and several other mechanical principles may be demonstrated. A long pendulum of thin steel wire and an iron bob B_1—Fig. 17—is suspended from the ceiling or wall bracket or, alternatively, is mounted in a frame. The pendulum bob is held at an angle to the vertical by an electro-magnet M_1, whilst another electro-magnet M_2, wired in series with the first, holds a steel release ball B_2.

the pendulum and ball being released simultaneously by a switch S. On falling to a neutral position the pendulum operates a gate switch G fulcrumed at X, whilst a trap switch fulcrumed at Y operates when struck by the falling ball B_2. When the impacts of the pendulum on the gate switch and of the ball on the trap switch are adjusted to synchronise, an indicator ball B_3 is released by a third electro-magnet M_3. As the periodic time of the pendulum can be calculated, the method consists in the adjustment of the height of the trap switch T, operated by the impact of the released ball, until its operation synchronises with that of the gate switch operated by the pendulum. The procedure when using the apparatus is to shut the gate, set the trap, and close the switch S, when the three electro-magnets hold the two balls and the pendulum bob. The trap is then fixed so that its distance from the release ball is approximately the same as the length of the pendulum. The switch S is then opened, when the pendulum and ball B_2 are released simultaneously. If the distance travelled by the release ball is insufficient, the trap switch

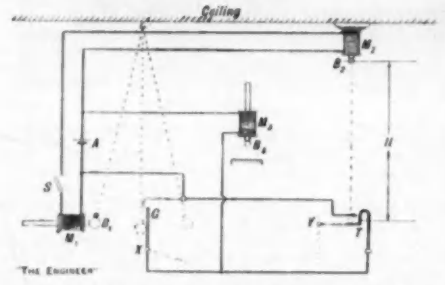


FIG. 17—APPARATUS FOR TIMING FALLING BODIES—GRIFFIN AND TALLOCK

closes the circuit before the gate switch opens it, and the indicator ball B_3 remains attached to its magnet. The procedure is then repeated, lowering the trap an inch at a time and then selecting two positions about one-tenth of an inch apart, the lower of which releases the indicator ball and the higher leaves the indicator ball attached. Finally, the distance through which the release ball travels to the trap is measured and the periodic time of the pendulum is also found.

(*a*) Let h be the fall in cms. and t the period time of the pendulum in secs.

The release ball hits the trap with a velocity of $g\frac{t}{4}$ cm./sec. The average velocity therefore is $g\frac{t}{8}$ cm./sec.

$$h = g\frac{t^2}{32} \text{ cm.} \quad \therefore g = \frac{32\,h}{t_2} \text{ cm./sec./sec.}$$

(*b*) Let the length of the pendulum be l cm., then—

$$t = 2\pi\sqrt{\frac{l}{g}}$$

$$t^2 = 4\pi^2\frac{l}{g}, \text{ which substituted in } (a) \text{ gives}$$

$$h = \frac{\pi^2}{8}l.$$

The pendulum may also be used for demonstrating the principle of the simple pendulum, the conical pendulum, simple harmonic motion, &c. The coefficient of restitution may be demonstrated by allowing the ball to drop on a sledge hammer head, &c.

(To be continued.)

The South-West England and South Wales Electricity Scheme.

THE Central Electricity Board has received from the Electricity Commissioners a scheme entitled "The South-West England and South Wales Electricity Scheme, 1929," which was published on Wednesday last. It deals with an area of about 17,234 square miles, covering the whole of South Wales, the counties of Hereford, Monmouth, Somerset, Devon, Cornwall, Dorset, Wiltshire and Southampton, parts of the counties of Berkshire, Gloucester, Oxford and West Sussex, and the Isle of Wight. At the last Census the area, which embraces densely populated industrial centres, including coal mining districts, important seaports, china clay and tin-mining districts, had a population of some 6,085,500. In the area there are at present 165 authorised undertakers, owning between them 107 public generating stations. The consumption of electricity in 1927–28 was about 77 units per head of population, and it is estimated that it will increase to an average of 205 units in 1935–36. Under the proposals six existing stations, one in the neighbourhood of Southampton and one in South Wales, will be selected and operated for the Board. The selected stations will be the Cardiff station of the Cardiff Corporation, the Hayle station of the Cornwall Electric Power Company, the Newport station of the Newport Corporation, the Portishead station of the Bristol Corporation, the Southampton station of the Southampton Corporation, and the Upper Boat station of the South Wales Electrical Power Distribution Company. Provision is also made for a further eleven stations to be worked under temporary arrangements for a few years, and it is also contemplated that a few of the remaining stations in outlying portions of the area will continue to be operated independently for the time being until it becomes economically practicable for the undertakers concerned to obtain supplies from the Board's system. Broadly speaking, it is contemplated that two of the selected stations, namely, Portishead, belonging to the Bristol Corporation, and the Upper Boat station, belonging to the South Wales Electrical Power Distribution Company, will supply the base load, while the remainder will be used for meeting the peak load. The stations will be interconnected by a series of high-pressure main transmission lines designed in a series of ring mains, so that there will be alternative routes to points of supply and, consequently, greater security against breakdown. The main transmission system will comprise 622 route-miles of line and 25 transforming stations. The secondary transmission will involve a further 11 transforming stations. Incidentally, the interconnection of these stations will result in the release for revenue earning purposes of about 180,000 kilowatts of plant now kept as spare and representing about £3,060,000 of capital.

The supply systems of the South Wales Electrical Power Distribution Company and of the Cornwall Electric Power Company are of the non-standard frequency of 25 cycles per second. There are also important private systems among the collieries in South Wales, some of which operate at a frequency of 25 cycles per second and others at frequencies of 40 and 33⅓ cycles per second. A careful investigation as to the feasibility and cost of standardising the frequency of the authorised undertakings in the area has been made by the engineers who have been assisting the Commissioners, and the matter has been considered in consultation with the officers of the two power companies concerned. The Commissioners have come to the conclusion that it is necessary, for the proper interconnection and working of the selected generating stations in the area, that the frequency of the systems of the authorised undertakers in South Wales and Cornwall should be changed to the standard of 50 cycles per second. The expenditure involved is materially less than that contemplated in other areas where standardisation has already been decided upon and is in process of being carried out. The estimated net cost of standardisation in the South-Western area when fully effected is £764,450. On the basis of interest at 5½ per cent. and a 40-year sinking fund computed on a 3½ per cent. table, the annual capital charges on standardisation in this area would amount to about £50,000. It should be noted that the annual charges in respect of the cost of standardisation of frequency carried out in this area, as well as in other parts of the country, in pursuance of the Act of 1926, will be brought into a separate account and will be apportioned by the Commissioners on a prescribed basis and borne by all authorised undertakers throughout Great Britain.

It is estimated that by the end of the financial year 1936–37, the capital expended under the scheme by the Central Board on transmission and standardisation of frequency, and by the owners of selected stations on the extension thereof will have been as follows :—

	£
By Central Board :	
Transmission lines and transforming stations, including capitalised interest	4,163,484
Standardisation of frequency	764,450
By owners of selected stations :	
On extensions of existing stations (117,500 kilowatts of generating plant plus equivalent boilers, together with additional boiler plant equivalent to 150,500 kilowatts)	1,934,360
Total expenditure	£6,862,294

On the basis of individual development by the various authorised undertakers in the absence of the scheme, involving no standardisation of frequency, it is estimated that provision would have to be made by 1936–37 for further generating plant in new and existing stations amounting to 322,725 kilowatts—inclusive of the above-mentioned figure of 117,500 kilowatts—and additional boiler plant, &c., to meet the load in the area and to allow for further immediate growth, representing an estimated capital expenditure of £4,085,900. To this figure there would have to be added further expenditure by certain of the company undertakers on main transmission lines, amounting to about £335,450, thus bringing the total expenditure in the area in the absence of the scheme to about £4,421,350. By the year 1936–37 a proportion of the existing spare plant in the several generating stations will have been released for revenue earning purposes under the scheme, such released plant amounting in all to about 180,000 kilowatts, and representing an original expenditure of about £3,060,000. Although the cost of standardisation in this area necessarily appears as part of the capital outlay under the scheme, the resulting annual charges thereon, as previously indicated, will not fall wholly upon the undertakers in the area. Deducting this outlay and allowing for the non-release of spare plant in the absence of the scheme, it appears that the system of interconnection for the South-Western area, providing important facilities for subsequent development, can be effected by a capital expenditure up to 1936–37 of £4,163,484, as compared with an investment of £5,546,990 under the existing system. Additional advantages will also accrue, for example, by reason of reductions in the cost of generation, and the comparison, if carried beyond the period under review—1936–37—would show progressive savings in capital expenditure under the scheme as contrasted with individual development.

The Commissioners have outlined a provisional plan of working the stations with the necessary estimates. These suggestions are, of course, tentative, since the working of the scheme, including the fixing of tariffs, is the responsibility of the Board, but taking the figures as they stand, it is of interest to note that the Commissioners estimate that in five years—1932–37—there will be a saving to the undertakers in the area of about £1,390,475, or an average of, roughly, £280,000 per annum.

Institution of Mechanical Engineers.

A VERY useful paper on "Protective Coatings for Iron and Steel" was read before the North-Western Branch of the Institution of Mechanical Engineers by Mr. E. O. Jones, B.Sc., on Thursday, January 9th. The author said that several alternative methods of preventing corrosion were available : (1) Another metal ; (2) paints ; (3) tarry or bituminous paints ; (4) cement or concrete ; (5) vitreous enamels ; (6) oxide or phosphate films, and (7) grease or oil films. He then described the methods of applying these various coatings and their peculiarities. The following is an abstract of the paper :—

Metal coatings may be applied either by (*a*) hot dipping, (*b*) electro-plating, (*c*) heating with metallic dust, (*d*) spraying with molten metal, or (*e*) mechanical welding. Metal coatings have certain inherent defects. In the first place none of them, with the exception of gold and platinum, is incorrodible, and, secondly, there is the danger of discontinuities in the coating which may give rise to a corrosion couple causing anodic attack of the more reactive metal. Where this is the underlying steel the attack may be concentrated on the small exposed areas, and the "protective coating" will have done more harm than good. If the coating is the more reactive, then the steel remains unattacked so long as it functions as the cathode, *i.e.*, it is protected by the "sacrificial corrosion" of the applied coating. The problem is further complicated by the fact that the same metal may function either as an anode or a cathode with respect to steel depending upon the particular conditions. Considerable judgment is therefore required in choosing a protective metal coat, and due regard must be paid to the service conditions.

Paints and varnishes protect the underlying metal by mechanical action and offer the advantage over metallic coats in that, being non-conductors, there is no electro-chemical action between the coat and any exposed metal. As against this they deteriorate in service and are liable to peeling and flaking and are, therefore, much less permanent. In general, four or five coats are necessary in order to provide adequate resistance to moisture penetration, and it is desirable that the priming coat should have an oxidised, or basic, pigment in order to maintain a passive oxide film on the metal.

Tarry and bituminous paints are more resistant than linseed oil paints and are therefore largely used where the atmosphere is strongly corrosive, as in chemical works. They are also used in marine engineering and as a protective coating for pipe lines, their insulating properties rendering them efficient protectors against corrosion due to stray currents. The drawback to their use on the interior surfaces of pipes, owing to the difficulty of obtaining a smooth surface, has been largely overcome by the modern methods of applying by "spinning" and "electro-deposition."

Concrete or cement has an alkaline reaction and will protect embedded steel or iron provided care is taken to avoid the presence of chlorides. Care should be taken that any sea sand used has been thoroughly well washed and the practice, sometimes adopted, of adding salt to the mixing water in cold weather should not be permitted on ferro-concrete work. The protective action of alkaline coments does not extend to lead and zinc, and from what has been said about the avoidance of chlorides it follows that cements of the oxychloride type do not confer protection.

Vitreous enamels are extremely resistant to corrosive media, but their brittleness and liability to "chip" are serious drawbacks where hard usage is required. Of recent years increased toughness has been attained and enamel ware is finding increasing favour in the chemical industry.

Oxide films which are produced in the "blueing" and Bower Barf processes are efficient while intact, but, being brittle, cannot be applied to materials which receive subsequent bending. In the costellising process a film of iron-phosphate, which is effective even when very thin, is produced. Such a coat is often used on nuts, bolts, washers, &c., and as an undercoat below the stove-enamelled coat on cycle parts.

Grease films are only used as a temporary protection for metal in storage. It is important that crevices and re-entrant angles should be coated as these are the points most prone to attack. Recommended materials are lanoline dissolved in benzine, or, where a coloured coating is required, a metal powder such as zinc, or aluminium, in heavy petroleum jelly.

As reported from Copenhagen on the occasion of the last Leipzig Spring Fair, collective participation was carried out for the first time by Danish exhibitors. Twenty-five firms took part in this enterprise, and it was so successful that the majority of the exhibitors will participate again at this year's Spring Fair. A union of Danish export firms has been established for this purpose. It has received a subsidy from its Government amounting to 15,000 Kr. In view of the great efforts being made at present by British merchants to increase the export trade of this country, it is suggested that the British Government might consider a similar procedure.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

DEFERRED PAYMENTS.

SIR,—Mr. Thomas in his Manchester speech mentions the provision he has arranged to enable various manufacturers to re-equip their works with the most modern production machinery. There is, however, another very important side of this credit question which he does not mention, viz., the extra credit or capital which the manufacturer will require to finance the production and sale of the goods when he has acquired the increased production facilities.

This is the more pressing as Mr. Thomas foreshadows his increase in business chiefly in the export market, where it is getting more and more necessary to grant extended terms of payment.

If the manufacturer used up his available security against the extra capital he has obtained for his works re-equipment, he is in a worse position than before to obtain further credits necessary to sell on extended terms of payment.

Some method, therefore, is necessary to enable him to obtain such credit entirely against extra wealth which he has created in the shape of finished and marketable goods. If he has put himself in a position to produce such goods at competitive prices through his re-equipment, then he has goods which are readily marketable in the world's markets at competitive prices, and therefore such goods represent a real asset and security. He has not, however, the security which the banker requires in the ordinary way. If he sells such goods by payment by bills, accepted by his customer, he can discount these up to a certain amount, provided they are for no longer periods than three, or in some cases six, months, and do not exceed a certain limit in amount, based on his and his customer's financial standing.

But in many industries, such as engineering plant and machinery, payment terms up to two or three years are frequently asked for, and these terms are accepted by our foreign competitors. This is a case where the assistance of the Government is required. These facilities are supposed to be offered now by the Export Insurance Scheme, but something simpler is required, and some scheme which can be more expeditiously available. These facilities must also be cheap, as the extra charge has to be added to the selling price.

It must be assumed that the manufacturers and merchants have availed themselves of the present facilities to the extent of their resources, but this has not enabled them to extend their sales sufficiently to absorb our unemployed men in work.

The Government should give their guarantee to manufacturers or group manufacturers in a much more liberal fashion, so that they would always be sure of these facilities. If any losses should be made, then these could be divided *pro rata* between the Government and the manufacturer, as the possibility of this loss to the manufacturer would deter him from entering into unduly risky transactions. The Government can even face the possibility of losses under this scheme, as they know the money so spent has gone in wages for the employment of men now out of work, and the loss would in any case be eventually less than the expenditure they will have to face to keep the men who are unemployed.

The machinery for granting these credits must be simple, the determining factor being the extra amount of labour which has or will be employed in producing the goods to sell. Where any industry possesses a representative manufactu ers' association, such could advantageously be used in the allocation of the credits.

Another very important factor in connection with such credit is that whereas the Government's risk of loss is confined to a proportionate value of the goods sold, the fact that such extra goods have been produced has enabled the workmen employed to spend more money, which has, in its turn, increased employment in those branches of trade which provide these requirements.

H. C. SIDDELEY.

London, S.W. 1, January 15th.

NEW L.M.S. RAILWAY HIGH-PRESSURE LOCOMOTIVE "No. 6399."

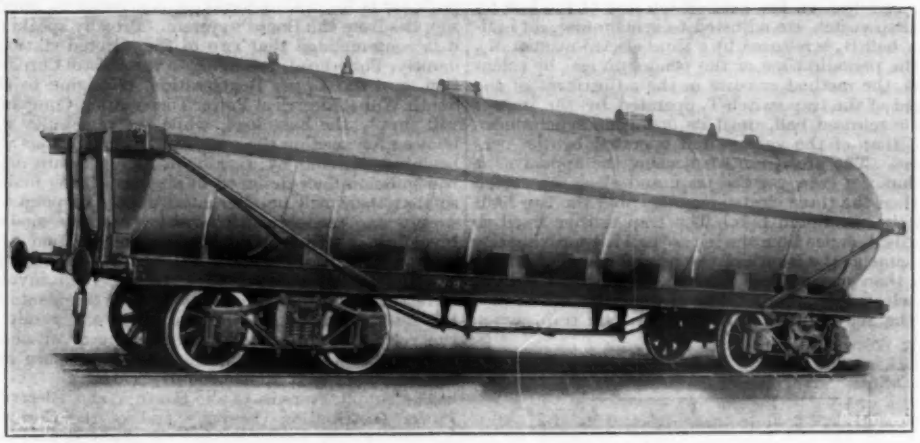
SIR,—Through your courtesy may I ask if some of your authoritative contributors would be good enough to inform me if the Perkins hermetic tube indirect heating system, as used in L.M.S. locomotive "6399"—*vide* newspapers—was successful with the London and Southampton Railway locomotives in 1836? (2) Was it extended to other locomotives and marine sets? (3) Did Perkins and Son combine their double pressure boiler (1823–27) with the hermetic tube heater? (4) How was the closed cycle continuous circulation grid type heating pipe attached to the side and bottom of the internally heated boiler? (5) In the reports—official—upon explosions of special boilers during 1928 several Perkins tubes burst while working after a hydraulic test of 5 tons (11,200 lb.) per square inch. Were any of these used for steam generating?

G. WATKINS.

January 15th.

35-TON BOGIE PETROL TANK WAGON

CHARLES ROBERTS AND CO., LTD., HORBURY JUNCTION, ENGINEERS



35-Ton Bogie Petrol Tank Wagon.

THE accompanying illustration shows a 35-ton bogie petrol tank wagon, which has recently been built by Charles Roberts and Co., Ltd., of Horbury Junction, near Wakefield. It is the first of its kind to run on English lines. As long ago as 1909 the same firm built a 40-ton tank wagon for carrying tar, but its use has been somewhat restricted, and for that reason no further orders for wagons of such a large size have been received. The present vehicle, however, goes a long way towards equalling the former wagon in dimensions.

The length inside the tank is 41ft. 3in., and the inside diameter is 7ft. 3½in., the capacity being approximately 1700 cubic feet. The length over the headstocks is 41ft. 6in., and, over the buffers, 44ft. 6in., while the height above the rails is 12ft. 2in. It is carried on two four-wheel bogies arranged at 28ft. 6in. centres. The bogies, which have a wheel base of 6ft., are of the diamond frame type. Each is fitted independently with a compound-lever hand brake. The hand levers are arranged one on each side of the main frame, and the brakes are applied to all four wheels of each bogie.

The main frame is built up of rolled steel channels, the two longitudinals being braced with truss rods of great strength. The buffing arrangements are in accordance with the Railway Clearing House requirements, the draw gear being arranged to pull behind the frame bolsters.

The tank is made up of six rings of steel plates, ⅜in. thick, connected together with a single line of rivets at the joints, the joints being caulked inside and out. The dished end plates are ½in. thick. The tank is carried on seven pitch pine cradles and is held securely in position by seven adjustable steel bands, as well as by end supports and longitudinal and horizontal tie-rods. A special feature of the tank is that it is divided into two compartments by a centre partition, which is strongly braced to the shell, so that the wagon may travel with one compartment full and the other empty. Each compartment is furnished with a manhole, a vent and a syphon, and the syphons are so placed that no alteration to existing installations, which are ordinarily served by 12 or 14-ton four-wheel wagons, is necessary. Incidentally, the syphons, which have a diameter of 4in., are adaptable to couple with existing 2in. fittings.

THE ROYAL INSTITUTION OF GREAT BRITAIN.

THE following arrangements for lectures during the before-Easter Session have been made by the Royal Institution of Great Britain:—

Friday evening discourses: January 24th, Sir William Bragg, K.B.E., D.Sc., F.R.S., Fullerian Professor of Chemistry, "Cellulose in the Light of the X-Rays"; January 31st, Lord Rayleigh, Sc.D., F.R.S., "Iridescent Colour in Nature"; February 7th, Leonard Hill, F.R.S., "Diving"; February 14th, Professor A. F. Pollard, "History *à la Mode*"; February 21st, not yet arranged for; February 28th, Professor G. I. Taylor, F.R.S, "A Tour in the East Indies"; March 7th, C. Tate Regan, F.R.S., Director of the Natural History Department, British Museum, "Angler Fishes"; March 14th, Professor G. Elliot Smith, F.R.S., "New Light on Vision"; March 21st, Seton Gordon, "Sea Birds and Seals," and March 28th, Sir Ernest Rutherford, O.M., LL.D., Pres. R.S., Professor of Natural Philosophy, "The Transmutation of Matter."

The Friday evening discourses begin at 9 p.m. During the reconstruction of the Institution Building, the discourses and the lectures will be delivered in the Newspaper Room on the ground floor.

General courses of lectures: Tuesdays, January 21st, 28th, February 4th, at 5.15 p.m., "Isotopes," by F. W. Aston, Sc.D., F.R.S.; Tuesdays, February 11th, 18th, 25th, March 4th, at 5.15 p.m., "X-Ray Determination of the Structure of Cellulose and Similar Substances," by Sir William Bragg; Tuesdays, March 11th, 18th, 25th, April 1st, at 5.15 p.m., "The Passage from Mediæval to Modern Science," (1) "Science in the Middle Ages," (2) "The Science of the Renaissance," (3) "On the Inductive Philosophy and Some of its Instruments," and (4) "The Scientific Crux," by Charles Singer, D.Litt.; Thursdays, January 23rd, 30th, 5.15 p.m., "The Growth of Children in Health and Disease," by Dr. H. A. Harris, Assist. Professor of Anatomy, University College, London; Thursday, February 6th, at 5.15 p.m., "Radio Direction Finding by Transmission and Reception," by R. L. Smith-Rose, Ph.D., D.Sc.; Thursdays, February 13th, 20th, "Architecture and the Industrial Arts of Pre-Spanish America," by T. A. Joyce, Deputy Keeper, Dept. of Ethnography, British Museum; Saturdays, January 25th, February 1st, at 3 p.m., "Sir Thomas Moore and His Friends," by R. W. Chambers, D.Lit., Quain Professor of English Language and Literature, University College, London; Saturdays, February 22nd, March 1st, at 3 p.m., "Nineteenth Century Painting in France and England," by William Rothenstein; and Saturdays, March 8th, 15th, 22nd, 29th, at 3 p.m., "Atomic Nuclei and their Structure," by Sir Ernest Rutherford.

THE QUARTER'S SHIPBUILDING RETURNS.

FROM the statistics issued by Lloyd's Register of Shipping regarding vessels under construction at the end of December, we note that in Great Britain and Ireland there was an increase of 111,899 tons in the work in hand as compared with the figures for last September, and that the present total—1,560,254 tons—was 317,460 tons greater than the tonnage which was being built at the end of December, 1928. It may be of interest to state that about 161,000 tons of the tonnage now in hand in this country are intended for the British Dominions; about 234,000 tons for Norway, and about 253,000 tons are for other foreign shipowners or for sale.

The tonnage under construction abroad—1,550,626 tons—was 181,642 tons greater than the work which was in hand at the end of September. Five countries abroad had more than 150,000 tons under construction, viz.:—Germany, 253,256 tons; Holland, 231,934 tons; Japan, 183,570 tons; United States, 179,062 tons, and France, 167,177 tons. The total tonnage under construction in the world amounted to 3,110,880 tons, of which 50·2 per cent. is being built in Great Britain and Ireland, and 49·8 per cent. abroad. The average percentages in the last twelve months before the war were 57·2 for Great Britain and Ireland and 42·8 for abroad.

In Great Britain and Ireland 499,020 tons were commenced—an increase of about 139,000 tons over the similar figures for the September quarter—and 472,938 tons were launched—an increase of about 103,000 tons. Similar figures for abroad were 477,484 tons commenced, and 370,180 tons launched. A large increase as compared with the previous quarter was shown in the tanker tonnage under construction, the present figures being 85 vessels of 627,756 tons, of which 52 vessels of 397,559 tons are being built in Great Britain and Ireland, and 8 vessels of 74,445 tons in Germany. It is of interest to note that of the 85 tankers under construction, 73 are motor ships. The tanker tonnage now being built represents over 20 per cent. of the total steam and motor tonnage under construction in the world. The tonnage of motor ships under construction in Great Britain and Ireland—765,912 tons—amounts to over 97 per cent. of the tonnage of steamers building, while the motor ship tonnage being constructed abroad—971,922 tons—exceeds by nearly 73 per cent. the tonnage of steamers. The continued progress in the employment of the internal combustion engine for the larger vessels is indicated by the fact that while there are now being built in the world 79 motor ships each of 8000 tons and upwards, only 28 steamers of such size are under construction. These figures include 15 motor ships and 6 steamers, each of 15,000 tons and upwards.

The table respecting marine engines unfortunately does not show complete world figures for marine engines of all types, as the figures for steam turbine engines being built in Germany are not available; but the table shows that the indicated horse-power of reciprocating steam engines now being built or being fitted on board amounts to about 540,000 horse-power, while the figures for oil engines aggregate about 1,502,000 horse-power.

THE Department of Overseas Trade desires to draw the attention of firms appointing agents in Greece to the desirability, wherever possible, of appointing separate agents for "New" and "Old" Greece. Trade in New Greece—*i.e.*, Macedonia, Thrace, &c., for which Salonika makes a suitable centre—is conducted on somewhat different lines from that of Old Greece, and cannot, as a rule, be adequately carried on by means of sub-agents appointed from Athens.

Railway and Road Matters.

THE breach in the sea wall near Dawlish Warren Station, which caused the Great Western Railway in that vicinity to be entirely closed, was repaired with commendable promptitude. The line was reopened for goods traffic on Thursday, January 9th, and for passenger traffic on the following day.

THERE was a serious collision on January 8th on the Great Western Railway at Stapleton-road Station, Bristol. A freight train was standing at the signals for Lawrence Hill Junction when it was run into in the rear by the 2.40 a.m. express from Shrewsbury. There were no serious personal injuries.

MAIL advices state that Mr. W. A. Webb, the Railway Commissioner of South Australia, will retire when his agreement expires on May 30th next, and will be succeeded by Mr. C. B. Anderson, the general superintendent. Mr. Webb came from the United States and has shown himself to be an excellent administrator.

PART of the work to be done by the Metropolitan Railway under the remission of the Railway Passenger Duty is the lengthening of the platforms at certain stations on the original section of that line. Two such stations are Euston-square—formerly Gower-street—and Great Portland-street. In order to get the work done more quickly—in six months instead of eighteen—it is proposed to close Euston-road, wholly or in part, against vehicular traffic whilst the work is being done.

WOODEN sleepers are being quickly replaced now in Germany by steel, and the German State Railway authorities, which own 97 per cent. of the German track, have just decided gradually to replace wooden sleepers by steel sleepers, except on such tracks as are more exposed to corrosion than the average. All tracks through tunnels, parallel lines to the coast or tracks in districts with great humidity will still be constructed with wooden sleepers, but approximately three-fourths of the total German railway mileage will be equipped with steel sleepers.

THE customary New Year Message to the staff on the various railways comes this year in the case of the London and North-Eastern, from Mr. William Whitelaw, the chairman. In it he says: "We have recovered millions of passengers and increased our freight traffic by millions of tons. We have many fewer engines lying idle under repair in our workshops, and we have made excellent progress in the improvement of our bridges and permanent way. Our whole organisation has worked with a success and smoothness which reflect credit upon our whole staff."

THE long-discussed need for the provision of ton-mile, passenger-mile and kindred statistics was brought to a close when the Ministry of Transport was established in 1919 under the exceptional powers conferred under the Establishing Act of that year. Their presentation was confirmed by the Railways Act, 1921, and a list of what was to be furnished was given in Schedule 8 of that Act. Until the standard charges had been approved by the Rates Tribunal and the "appointed day" had arrived, the scheme could not be fully operative. The annual railway returns are affected thereby and the necessary new form was approved by the Minister of Transport in December, 1928. That has now been published, together with annotations showing the changes, as a Stationery Office publication, price 4s.

THERE has been considerable and interesting correspondence in *The Times* recently on the question of cross-Channel steamers designed to reduce the inconvenience of sea sickness. The first such vessel was the "Bessemer," which made her trial trip on May 7th, 1875. She was a failure, as not only did the saloon oscillate, but did it in an uncomfortable and dangerous manner. The "Castalia," a twin ship, was tried in the summers of 1876 and 1877, and was pronounced to be the most comfortable boat on the station, but "desperately slow." The "Calais-Douvres" was built to replace the "Castalia," and put into service in March, 1878. She was of the same general design and, compared with her predecessor, a swift traveller. At the half-yearly meeting of the London, Chatham and Dover Company in February, 1883, it was said that the "Calais-Douvres" had amply justified the large expense of her original purchase, the working cost, and the novelty of the experiment. The same company had, however, meanwhile got faster boats and, of greater importance, so had the South-Eastern, and the "Calais-Douvres" was withdrawn in 1887. It was then admitted that she was too slow for the service, her coal consumption was extravagant, her operations generally expensive, and her peculiar construction often created difficulties in handling.

IT will be ten years on the 28th of next month—February—since the Transportation Act, 1920, was passed by the United States Congress. A requirement laid down therein was that "the [Interstate Commerce] Commission shall, as soon as practicable, prepare and adopt a plan for the consolidation of the railway properties of the Continental United States into a limited number of systems. In the division of such railways into such systems under such plan, competition shall be preserved as fully as possible, and wherever practicable the existing routes and channels of traffic and commerce shall be maintained." Contrary to the experience in this country, where grouping was accomplished within little over a twelvemonth, the proposals for the American railways have only just been published. The scheme provides for the consolidation of all the lines into twenty-one systems. Under the original Act hearings were to be given to "all persons who may file or present objections thereto," and "after the hearings are at an end the Commission shall adopt a plan for such consolidation and publish the same." The view we have always taken of these powers has been that the authority of the Commission ended with the preparation and adoption of the "plan." Certainly, there is nothing in the Act to compel the railway companies to agree; it is, however, strange that the Commission did not get compulsory powers. Doubt as to how the matter stands now prevails in the United States, and the New York correspondent of the *Manchester Guardian* says: "In any case, it seems certain that before any such action is taken, supplementary legislation will be asked of Congress."

Notes and Memoranda.

AT the Dominion forest nursery, maintained by the Forest Service, Department of the Interior, at Indian Head, Saskatchewan, fence posts of poplar, creosoted, have lasted from 1917 to the present, and are still sound. Untreated posts, on the other hand, have rotted out in two or three years. Efforts are now being made to devise an apparatus for treating posts which will enable any farmer to set up a simple home treating plant at small expense.

A DEVICE intended to disperse fog sufficiently to enable vehicle drivers to see their way for some distance ahead is being developed by Sphinx Electric, Ltd., which has acquired the rights of the method from two London men. The idea was suggested by the fact that when a brazier is lighted during foggy weather an area of clear air surrounds the fire, caused by the drying of the atmosphere. The "Fog-gon" operates on the same principle. It emits a stream of hot air before the vehicle to which it is fitted, and a lamp may be so incorporated as to intensify the clear air beam. The heat is produced electrically and the air stream by a motor-driven fan. It is reported, states the *Electrical Review*, that the London General Omnibus Company and the Metropolitan Electric Tramways, Ltd., are experimenting with the apparatus.

ACCORDING to a paper read before the American Society of Mechanical Engineers, by Mr. A. G. McKee, the dimensions for a blast-furnace to produce 1000 tons of pig iron a day should be:—Hearth diameter, 25ft.; bosh diameter, 27ft.; stock-line diameter, 20ft.; bell diameter, 15ft.; total height, 95ft.; bosh height, 10ft.; straight section above mantle, 10ft.; angle of bosh deg.-min., 84–17; slope of inwall (in./ft.), 13 to 16. It may be predicted that a furnace of these dimensions, if provided with lake ores of average iron content and with a good grade of coke, will produce 1000 tons of pig iron per day. The flue-dust losses should be low if the downcomers are designed properly. Little or no scrap should be necessary to accomplish this tonnage, but there should be adequate provisions for heating the blast to 1500 deg. Fah.

A PIPE line 205 miles long, recently laid from Jal, New Mexico, to El Paso, Texas, was electrically welded. This pipe line, which is 16in. in diameter, carries gas for the El Paso Utilities Company. The electric arc welding of the entire pipe line was effected by twenty-seven General Electric welding equipments, some mounted on Fordson tractors and driven by the tractor engine, and others mounted on trucks and trailers. The pipe, in 30ft. sections, was strung along the cleared right-of-way. Seven of the 30ft. lengths were lined up and welded, making a section approximately 200ft. long. One crew fixed the sections temporarily in position by tack welding and another completed the welds. After the 200ft. sections were completed, another crew lined them up and welded them with the completed pipe line.

AN interesting account of experience gained in planting teak (*Tectona grandis* L.f.) in Trinidad is given by Mr. R. C. Marshall, Conservator of Forests, in *Tropical Woods* (1929, No. 19, p. 1). Teak was introduced into the Colony in 1913 by Mr. C. S. Rogers, then Conservator of Forests, who imported seed from Burma. The experiments have been a marked success, the oldest plantations—fifteen to sixteen years old—having an average height of about 70ft. and showing, on a sample plot, a mean annual increment of 126 cubic feet per acre—quarter-girth measurement, under bark, to a 3in. minimum diameter of stem wood. It is stated that a rotation of about sixty years is likely to be adopted. A considerable quantity of seed for planting is now available from the young plantations, for the trees bear fertile seed at an early age. No difficulty has been experienced in obtaining rapid germination, which, it is understood, is sometimes difficult to secure in Burma. Seedling growth is rapid, a height of from 3ft. to 6ft. being reached in the first rains under favourable circumstances.

THE Advisory Committee on Tanning Materials of the Imperial Institute, having considered the results of the investigation and the information relative to the prospects of collecting the leaves of the Dhawa tree in India on a commercial scale which had been furnished by the Forest Research Institute, Dehra Dun, has expressed the following opinion:—The leaves are very rich in tannin and generally of satisfactory composition. They promise to be a very useful tanning material, and would no doubt take a prominent place among tanstuffs for the light leather industry, but it would be unwise to consider the material as a rival to true sumac. With reference to the difficulties which have been experienced in India in drying large quantities of the leaves in the shade, involving the risk of fermentation and consequent loss of tannin, the Committee suggest that it would be desirable to investigate the possibility of employing sun-dried leaves. If leaves prepared in this manner prove to be of sufficiently satisfactory quality the difficulties of preparation should to a large extent be overcome.

THERE is an extensive literature on the effect of employing calcium chloride or sodium chloride as a protection for mortar or concrete against frost. For domestic purposes at the Building Research Station, and in order to enable the station to deal with frequent inquiries on the subject, it was felt desirable to prepare a summary. This summary, by Dr. Thomas, shows that, although a great deal of experimental work has been done in the past by different investigators, there still remains a considerable amount of uncertainty, and often the results are, apparently, at variance. The variations may be due occasionally to differences in the test conditions, but it is suspected that the causes are of a more fundamental nature. The exact significance of the variations has not been determined, and the station has not, so far, been able to devote its attention to the study, which is evidently necessary, of the more fundamental aspects of the reactions involved. The report therefore does not purport to present new information on the effects of the salts—it is somewhat in the nature of an extended bibliography—but it is published in its present form, at the price of 9d., by H.M. Stationery Office, for the convenience of those who desire some information on the subject from the Building Research Station.

Miscellanea.

A NEW dry dock is to be built at Hebburn-on-Tyne.

TWO new ironfoundries are being organised in Calgary, Alberta.

A COKE oven plant is to be put up at Lake Erie Port, Ontario, at a cost of 3,000,000 dollars.

IT is intended that the output of the Falconbridge nickel mines of Ontario should be 4000 tons of refined metal a year.

PROPOSALS for the transmission of natural gas for distances as great as 1000 miles are being considered seriously in Western America.

IT has been decided by Imperial Airways that the new aerodrome for the Transvaal shall be at Germiston, about 10 miles from Johannesburg.

IT is announced that an extensive scheme of harbour works, hydro-electric development and sewerage is to be undertaken at Noumea, New Caledonia. The contracts will probably go to Germany.

THE death-rate from accidents in the coal mines of the United States for the month of November was 3·44 per million tons of coal mined, as compared with 3·27 for October, 1929, and 3·18 for November, 1928.

THE production of railway metals by the Japanese Government works at Yawata is reported to be so much in excess of native requirements that efforts are being made to export rails to Siam, China, and other Far Eastern countries.

By Order in Council, dated December 17th, 1929, the provisions of Sections 48 and 91 of the Patents and Designs Acts, 1907 to 1928, have been made applicable to Trinidad and Tobago. The Order, which revokes that of August 12th, 1907, is cited as the Patents, Designs and Trade Marks (Trinidad and Tobago) Order, 1929.

A MESSAGE from Valparaiso states that it has been decided to proceed at once with the construction of docks at Tocopilla. This important free port is one of the chief shipping points for copper and nitrate, there being eleven oficinas there with a monthly production aggregating 500,000 tons. Ships must now anchor about a third of a mile from shore.

THE Spanish Government has decided to carry out additional port works at Melilla, and a contract for them has been entered into. The principal work will be the repair and extension of the north-east mole and the construction of a section of the south mole in the harbour. At present the latter is accessible only to small vessels, although the outside roadstead is safe, with deep water a mile to the east of the fortress. These works are estimated to cost £500,000 and must be completed in four to five years. Further works for widening and improving the landing place in the harbour, where the mole is cut out of the rock leading to the upper town, are to be carried out at a cost of between £350,000 and £400,000.

MUCH interest is, says the *Iron and Coal Trades Review*, being evinced in a geophysical test being made in the Bendigo (Vic.) district by a Mr. Anderson. The Fraser-Hertzian electrical wave ore finder is being used. The experts will carry out exhaustive tests on the Bendigo goldfield, and will produce charts showing the position of reefs, the extent of the ore bodies, and some indication of the gold contents. Mr. Anderson states that the instruments have proved dependable in recording the existence of lodes within a range of 2000ft. The instrument can be operated either vertically or horizontally. He expected to finish in a fortnight the testing of the New Red, White and Blue mine from the surface to a depth of 2000ft., and to produce a chart showing the worked and unworked reefs in the undeveloped areas of the Bendigo field.

THE Report of the Royal Commission on Radio Broadcasting in Canada, which has just been issued, recommends the establishment of a Government-owned company, to be known as the Canadian Radio Broadcasting Company, which would control and operate stations throughout Canada for the organisation of wireless programmes. If the Report should be adopted, seven high-power radio stations would be erected in Canada to provide the service initially suggested by the Radio Commission. These would be 50,000-watt stations, and supplementary stations of lower power would, if necessary, be erected in local areas not effectively covered by the main stations. The estimated cost of the main stations is 3,000,000 dollars, and of the smaller units 250,000 dollars, and the estimated cost of operating the entire organisation is 2,500,000 dollars annually. The Commission recommends that, pending the inauguration and completion of the proposed system, provisional services should be provided through certain existing stations.

THE inauguration of the new Marconiphone wireless equipment at the Royal Hospital, Chelsea, formed the subject of an interesting broadcast by the B.B.C. on Wednesday afternoon, January 8th. The installation was handed over by Viscount Cowdray and received by Lord Arnold on behalf of the Commissioners. Both speakers paid a tribute to the efforts expended in raising the fund which made the installation possible. Appreciation of the great benefits conferred by the new equipment was also voiced by the ninety-year old senior pensioner, who anticipated many happy hours for himself and his comrades. The installation comprises a unit system amplifier employing eight valves. This supplies 576 pairs of headphones divided into four banks, each operated by its own output valve. The banks are then sectionalised and each section provided with its own switch and volume control, the whole system being thus extremely flexible. All power required is derived from the 230 volts D.C. mains, but special provision for an A.C. input has been made in view of an approaching change over to this form of supply. The receiver is normally tuned to London and automatically switched on at selected times, thus requiring no attention. In spite of the fact that an indoor aerial is used, heavily screened by a lead roof, it is also possible to receive a number of stations when required. In addition provision is made for the use of a gramophone pick-up and microphone so that a wide variety of matter is available for the entertainment of pensioners.

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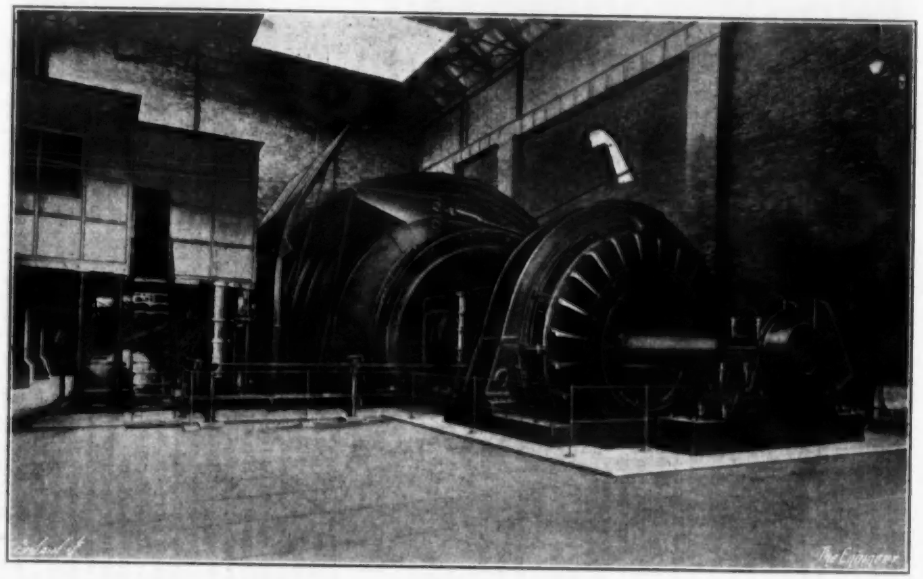

FIG. 1—THE COMPLETED WINDER

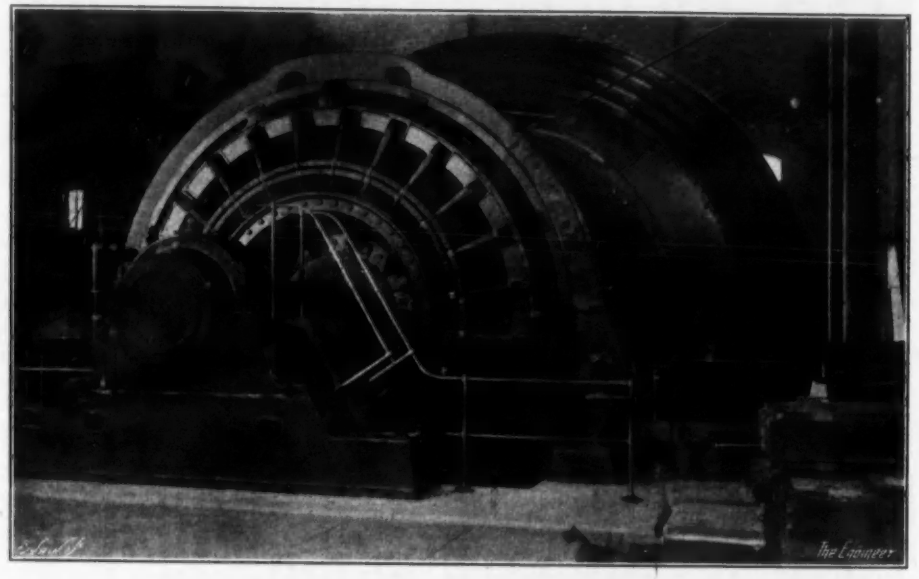

FIG. 2—END VIEW OF MOTOR

FIG. 3—EARLY STAGE OF ERECTION

FIG. 4—ERECTION NEARLY COMPLETED

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JANUARY 17, 1930.

Ten Thousand Volts.

TIME has moved so rapidly in the development of electrical engineering that our younger men may be forgiven if "Ferranti" means little more to them than a firm of manufacturers. To those, however, who can recall, from personal knowledge, the struggles and anxieties of those days, some forty to fifty years ago, when the invention of the incandescent electric lamp provoked an electricity mania, the announcement of the death of Dr. de Ferranti brings back memories of a great power station at Deptford and of a young pioneer who defied accepted standards, invented novel machines and novel methods, devised a new form of cable, and generated and transmitted alternating current at the unheard of pressure of 10,000 volts. Whilst others, with less vision and more financial wisdom, were content to stump along the easy high road, Dr. de Ferranti must cleave his rapid way through the air and leap at a goal beyond their ken. He was a score of years before his time. He had the courage to draw a logical but daring conclusion from sound premises and to put it into effect. That he would have been wiser in his generation had he bitted his ambition is neither here nor there. Pioneers and seers are not to be controlled by common reason. They are lovers and do not see as other men.

"La Raison me le dit chaque jour
Mais ce n'est pas la Raison qui régle l'Amour."

Deptford failed, but Ferranti won. He brought a new idea into the world; he was the father of the thousand long-distance power stations that the world possesses, and his name will live for ever in the history of engineering.

In the memoir which we print on an adjoining page an account is given, not only of the Deptford station and its machines, but of the other inventions with which Dr. de Ferranti's name is associated, and it is unnecessary to allude to them here. We may, however, say that every step in the development of the Deptford station was followed in our columns, and in THE ENGINEER during the years 1888 to 1890 many articles and illustrations of the building, the alternators, and the engines will be found. The fact that nearly all the photographs were reproduced by wood engraving—now, alas! gone for ever—takes the wonderful history back into an age unknown to the present. de Ferranti was a persistent patentee, and although many of his inventions came to nought at the time, yet he lived to see not a few of them widely adopted. Take, for example, such a small thing as the Litzendraht wire, familiar to wireless experimenters. It consists of a cable composed of a number of wires all insulated from each other, and is based on the principle that electricity is carried on the surface of the conductor. That principle was appreciated by de Ferranti and made use of in some of his earlier developments of high-tension cables, which were constructed in just the same way, though the individual wires were not of the hair-like proportions used by the winder of wireless inductances. His main cables for Deptford were a marvel, not only of electrical knowledge, but of mechanical skill. They consisted, as our readers know—at least those whose memories are mature—of two concentric copper conductors insulated from each other with paper and placed in an iron tube from which they were also insulated. This tube was drawn down tight on to the inner tubes—an ingenious plan. In building up miles of conductors of this kind a clever mechanical device was employed to bring the ends of the tubes, each about 20ft. long, into intimate electrical contact. The conductor thus made was, of course, a rigid one, and has long since been superseded, but how excellent it was, in all respects, for its purpose is made manifest by the fact that now, at the end of thirty-nine years, mains so constructed are still in constant use and give practically no trouble whatever. All de Ferranti's early work was done with reciprocating engines—one of 10,000 H.P. was built but never erected—but he contributed not a little to the development of turbine engineering, and reheating, which he adumbrated many years ago—see his James Watt Lecture of 1913—is now coming into extended use. Of late years he had devoted much attention to the problems of the internal combustion turbine. But it is by his plans for electric transmission of power that his name will be remembered. That was his great subject, and the large scale on which he handled it, and his anticipation of the scheme of national electricity supply, in his presidential address to the Institution of Electrical Engineers, will not soon be forgotten. He always appeared to be far ahead of his time, yet the future always caught him up, and he saw the surpassing of his most visionary schemes.

Such men as he come into the world but rarely. Their composition requires the happy combination of many qualities: energy, courage, vision, the ability to seize upon essentials, the inventive instinct and the power of influencing the minds of other men. This country has been fortunate in the production of many such geniuses, engineers who have been at the root and basis of limitless changes. To de Ferranti the world owes high-tension transmission, and there is yet happily amongst us Sir Charles Parsons, who provided the only element that was needed to make all that de Ferranti foresaw come from fairyland into the workaday world. What more he would have done none can say. He might yet, in his declining years, have brought to fruition another revolutionary invention, but he could never have done anything greater than what he achieved when, but little more than a youth, he transmitted electric energy at 10,000 volts.

The Availability Factor of Boiler Plant.

FROM the commercial point of view the best boiler plant is that which will produce the required quantity of steam for the least money. The calculation must, of course, be made by taking into account interest and depreciation on the capital expenditure, as well as the cost of fuel, labour, maintenance, and other operating charges. The handicap which excessive capital expenditure imposes on a boiler-house need not be emphasised. Every year the amount of money required for the service of the capital has to be deducted from what would otherwise be net profit, with the result that economies made possible by the lavishness of expenditure may easily be neutralised by the higher fixed charges which the extra expenditure has entailed. The problem of deciding how great a capital outlay is permissible in any particular case is too often regarded as a question of what elaborateness of equipment the conditions will warrant. There is, however, a much broader aspect. Every boiler unit which is out of commission for cleaning, overhaul, or repairs to any part of its equipment constitutes a charge on the station in a double sense.

The cost of the work done to it and the charges on the capital lying idle have both to be borne by the output of the units which are at work. The question of keeping capital and maintenance charges to the minimum therefore turns largely on the proportion of the plant which can be kept continuously in service, and this again depends mainly upon the number of hours each individual unit is in a condition for steaming during the year. Expressed as a percentage of the total time, the time during which a boiler is available for service may be called its "availability factor," and the importance of this factor lies in its close relationship with the amount of money which has to be expended in providing spare plant. The converse to availability has come to be known by the rather barbarous word "outage," meaning the time that the plant is out of commission for any reason whatever.

The causes which bring about "outage" of a boiler unit are numerous. Apart from the necessity of laying it off for periodical inspection, cleaning and overhaul, the plant may have to be shut down for a longer or shorter period for furnace repairs, tube replacements, stoker troubles, or failure of any of the multitudinous and ever-increasing auxiliaries which are essential to its proper working. Every central station engineer who has kept proper records over a sufficient length of time, can tell the average annual outage of his own particular boiler plant, but there is no information generally available, by means of which he may compare his experience in the matter with those of other engineers. Whether one type of steam-raising plant is more subject to outage than another; what percentage of outage time is reasonably to be anticipated; whether outage tends to increase with higher pressures, greater furnace temperatures, or higher rates of evaporation; what relative responsibility the firing mechanism, the furnace, the boiler, the economiser, the superheater, and the various auxiliary appliances have for causing the plant to be out of commission are all questions to which the answer is sought as eagerly by users as designers of boiler-houses. Up to the present, speculation, judgment, and no doubt also the dangerous habit of drawing general conclusions from insufficient data, have constituted practically the only basis for such opinions as have been held. In order that some definite knowledge could be obtained as to the extent of outage of modern boiler plant, and of the causes responsible for this outage the Central Stations Committee of the Power Division of the American Society of Mechanical Engineers requested Messrs. C. F. Hirshfeld and G. U. Morgan, both of the research department of the Detroit Edison Company, to do what was possible to ascertain the facts. With this object, special daily operating boiler-room log sheets were sent out to sixty-four selected power stations equipped with boilers working at pressures of more than 250 lb., and all having heating surfaces of over 10,000 square feet, except that a few with slightly less surface were included on account of their high rate of heat transmission. The useful data obtained referred to 186 boilers in fifty separate stations and covered consecutive periods ranging from ten to twelve months. Of the total number of boilers considered one hundred and one were stoker-fired, sixty-two fired by powdered coal, seventeen by oil or gas, and six by combined arrangements of coal with oil or gas. The results of the investigation are given in some detail in a paper by Messrs. Hirshfeld and Morgan, entitled "The Performance of Modern Steam Generating Units," and published by the A.S.M.E. The authors state their conclusions with a proper diffidence, pointing out the danger of relying too strongly on the indications of not more than twelve months' experience of a comparatively limited number of boilers, with all the unknown factors due to difference in the nature of operators. They believe, however, that the evidence shows that details of design and construction, together with skill in operation, are far more important in giving a high availability factor than are such things as rate of heat transmission, type of fuel burnt, methods of firing, or many of the other variables which have been considered as of special influence in determining outage. Nor do the data bear out the idea that boiler outage is proportional to severity of use. Indeed, as the authors mention, the figures actually show more outage for boilers working at low rates of heat transmission than for those working at comparatively high rates. If the rate of heat transmission is considered with reference to furnace volume, rather than to area of heating surface, the same tale is told. Taken at their face values, the statistics would even indicate a slight increase in the availability factor with increased severity of operation. The most probable explanation of this fact, if it be a fact, would appear to be that the higher-rated boilers are either better designed or more carefully managed. Another interesting conclusion from the data is that there is no evidence that the availability factor is improved or otherwise by the use of powdered fuel, instead of mechanical stoking. When the results are plotted, the points corresponding with the alternative methods of firing are so intermingled that one is forced to the view that questions of design and operation are of far more importance than whether the fuel is burnt in the solid or the pulverised form. As regards the effect of working pressure, boilers operating at less than 300 lb. per inch seemed to show a fractionally greater availability factor than those at higher pressures, but the difference was hardly significant. The use of preheated air, on the other hand, appeared quite definitely to increase the outage time. The average availability factor for stoker-fired units fell from 85·6 per cent. with cold air to 80·0 per cent. with heated air; the corresponding figures for units fired with pulverised coal were 90·1 per cent. and 84·9 per cent., and for oil and gas fired units 93·8 to 87·7 per cent.

Useful and suggestive as is the statistical work undertaken by Messrs. Hirshfeld and Morgan, one cannot help regretting that it was not founded on a broader base, and carried out over a longer period. The fact of admitting an unstated number of records extending over ten months only, obviously raises the question as to whether the outage due to the annual inspection and overhaul was included or not. Then, again, among the boilers considered, the steaming time of individual units is shown by the tables to range from 19·6 to 93·2 per cent. of the period under review; the duration of the banked time varied from zero to 50·5 per cent. of the total; the time standing cold as a reserve varied from zero to 42·6 per cent., and the time out of commission for one cause or another lasted from zero to 57·0 per cent. of the total period. With such extreme variation in operating conditions, anything in the nature of an average figure for availability has very little significance. Moreover, since the availability factor, by definition, includes time when the boiler is either steaming, banked, or standing cold, but ready for service, and gives equal weight to all three conditions, it clearly is not a perfect measure of merit. A boiler, for example, standing cold the whole year round would be credited with 100 per cent. availability, whereas another doing useful work for forty-five weeks and down for repairs for the remaining seven weeks, would only have an availability factor of 86·5 per cent. The real question, as it affects the central station engineer, is how many hours of actual service per year he can count on for a particular kind of plant, and we would like to see this question discussed before one of the Institutions in the light of the records which are certainly available in British power stations.

Railways in 1929.

BY the continued courtesy of the Chief Engineers we are enabled to give the following report of the engineering activities of the four grouped companies during the past year.

London, Midland and Scottish.

London: Broad-street.—The work of extending Nos. 1 and 2 platforms by 260ft. in order to give each a total length of 700ft. to accommodate the Southend trains was completed.

Tilbury.—This station is being remodelled and enlarged in connection with the provision, jointly with the Port of London Authority, of a deep-water pier. A year ago we reported that contracts had been placed for the circulating area of the station and for the station buildings. The roof over these parts is now well in hand and some of the buildings are complete.

Northampton: Castle Station.—Considerable additional accommodation is being provided in order to deal with the down traffic between London and Rugby. It includes a new down loop, 1000 yards long; five storage sidings with a capacity for 433 wagons and ten sorting sidings for 850 wagons. The work involves the removal of 60,000 cubic yards of excavation, of which 11,800 cubic yards have been done. The new loop is in use and the storage sidings are being laid.

Edge Hill and Speke Junction.—The additional sidings at Edge Hill, mentioned herein a year ago, have been completed. They necessitated the removal of 67,000 cubic yards of material, which was taken to Speke Junction, where additional reception, sorting and storage sidings had to be provided for the increased timber traffic through Garston Docks. The latter work is now practically completed.

New Railways and Extensions in Nottinghamshire.—The account of this work occupied considerably more space in our article a year ago than any other item. All that was then mentioned has now been completed. It includes: The Clipstone Colliery branches Nos. 1 and 2; the new curve between the Nottingham–Lincoln main line and the Southwell–Mansfield branch; the conversion from single track to double of the Southwell branch from Rolleston to just south of Southwell Station; the extension of loops and sidings at Rufford Colliery, at Mansfield Colliery and at Welbeck Colliery.

In this vicinity is the Mid-Notts Railway, which, being jointly owned with the London and North-Eastern, is the subject of a separate note below.

Beeston.—The additional traffic brought by the above-mentioned extensions in Nottinghamshire has necessitated considerably increased siding accommodation at Beeston. The sidings there are being remodelled and additional accommodation, amounting to approximately 26,000 lineal yards, provided. There is also to be an engine turntable, coal stage and sidings. About 148,000 cubic yards of filling will be necessary, of which approximately 35,000 cubic yards have been laid. New sidings are being put in as the work progresses.

Goole.—For dealing more expeditiously with coal for shipment two additional reception lines and seven loaded wagon sidings had to be provided, together with the conversion of a group of dead-end into double-ended sidings, with a reception line and a shunting neck. Some 56,000 cubic yards of filling were required.

Rossington Main Colliery Branch.—This is a new line, about 1¼ miles long, leading off the Dearne Valley Railway. About 35,150 cubic yards of filling are necessary and some 26,550 cubic yards are already in. About two-fifths of the permanent way has been laid and a contract for the construction of the bridges has been let.

Longbridge and Barnt Green Widening.—This is the conversion from two to four tracks of 2¾ miles of railway, and includes the opening out of Cofton Tunnel, which is 440 yards long and 80ft. deep. A year ago it was reported that about 140 yards of the latter work remained to be dealt with. The whole of the widening is now practically completed, and the permanent way work is proceeding.

Manchester.—The joining up of the Victoria and Exchange stations so that they are under one roof, together with the provision of a large installation of all-electric power signalling, was completed in time for the Easter traffic.

Fleetwood.—When the existing fish dock at Wyre Dock was opened in 1908, the regular trawlers using it numbered 60; there are now 180, and many are much larger than those that originally used the port. Great improvements are, therefore, being made to provide for the increased business and in anticipation of further developments.

London and North-Eastern.

King's Cross.—The locomotive accommodation is to be greatly enlarged and improved in order better to provide for the 178 engines, including ten of the "Pacific" class, stationed there. There is to be a mechanical coaling plant of 500 tons capacity, and the 50ft. turntable is to be replaced by one of 70ft. diameter. The work is in hand.

Clacton-on-Sea.—This station has been considerably improved by the lengthening of the two island platforms and the enlargement of the circulating area from 4500ft. to 11,690ft. Alterations to the goods yard and locomotive depôt are now in hand.

Walton-on-the-Naze Branch.—Owing to coast erosion the line between Frinton and Walton-on-the-Naze has had to be carried further inland. The work is completed and will probably be brought into use towards the end of this month (January).

Whitemoor Yard, March.—The new marshalling yard, which has Frolich retarders for braking the wagons after they leave the hump, and electric and automatic point operation, was brought into use early in the year.

Branch Line at Doncaster.—A new railway, 1 mile in length, to develop the Wheatley Estate of the Doncaster Corporation and to serve new industrial premises, is in course of contruction. It involves the building of a bridge over the Sheffield and South Yorkshire Navigation.

Hattersley Tunnels.—These two tunnels, between Godley and Mottram, are respectively 100 yards and 266 yards in length and are separated by an opening of 110 yards. They are being opened out and a total of 700,000 cubic yards of material will have to be removed. About three-fourths of the work has been completed.

Hull and Barnsley Railway.—Several bridges on this section have been strengthened by electric welding. In such cases additional plates have been welded to the girder frames and sufficient strength thereby obtained to render complete renewal unnecessary.

Newcastle.—The approach road to the new high-level bridge over the Tyne has been carried under the Newcastle-Berwick main line by means of a new bridge at Pilgrim-street. The work was executed in four separate sections—one for each running line—and

involved erection work under strictly limited conditions.

Heaton.—What is probably the first welded structure in this country is the new carriage washing shed at Heaton. It consists of ordinary steel sections connected by means of electrically welded fillet joints.

Bedlington Viaduct.—This excellent example of heavy timber trestle work was opened in 1850. It is now being replaced by a nine-span steel plate girder bridge carried on braced steel towers. The total length is 664ft. and the maximum height above the river bed is 72ft.

Tayport Branch.—This line, which runs from Leuchars old station to Tayport and is 5 miles in length, was converted from a double to a single line.

Bridge Work in the Scottish Area.—The strengthening of the floor of the South Esk Viaduct, which has been proceeding for the last four years, was completed. The strengthening of the floor of one of the spans of Burntisland Viaduct was accomplished. In this case electric welding was utilised for the first time in the Scottish area in connection with bridge repairs. Extensive repair work is being carried out on an underbridge near Kelty, on the main Perth line, the foundations and abutments of which were undermined by flooding of the river Ore in the winter of 1928.

London, Midland and Scottish and London and North-Eastern Joint.

These companies are jointly interested in two important works, *i.e.*, the Mid-Nottinghamshire Joint Railway and the electrification of the Manchester South Junction and Altrincham Railway.

Mid-Nottinghamshire Railway.—The construction of this new line was begun during the year and good progress has been made. It will be nearly 8 miles long. Its northern, or L. and N.E., terminus is at Ollerton, on the Lancashire, Derbyshire and East Coast section of the former Great Central, and its southern, or L.M.S., end is near Farnsfield, on the Mansfield and Southwell branch of the old Midland Railway. The work involves the removal of some 920,000 cubic yards of cutting, and the construction of twenty-four bridges and one viaduct. A new joint committee was authorised under the empowering Act for the construction and administration of the railway.

Electrification of the Manchester South Junction and Altrincham.—This work, which involves the installation of 1500 volts direct-current overhead equipment, was started in the spring. It calls for the provision of two sub-stations; improvements to, and the necessary additional equipment in, the carriage shed at Altrincham; the lowering of the line at several bridges; two additional stations; the conversion of that at Old Trafford into a suitable residential station, and new electric rolling stock.

Great Western.

Paddington.—The second instalment of the reconstruction of the goods station was completed.

Bristol.—The enlargement of Temple Meads goods yard was completed. The work includes extensive new covered platforms covering an area of nearly 6 acres.

Royal Albert Bridge.—The reconstruction of the east and west approach spans was completed and the main girders of the two river spans are now being strengthened. This work was the subject of an article, with a two-page Supplement, in THE ENGINEER of June 21st last.

Ponsanooth Viaduct.—This is a timber viaduct, of eleven spans, of a total length of 650ft., between Perranwell and Penryn stations, on the Falmouth branch. Its replacement by one of masonry piers and brick arches progresses.

St. Erth and Marazion.—The length of 3½ miles of single line between these two stations, which are those immediately preceding the terminus at Penzance, was converted to double line.

Appledore Viaduct.—This bridge, which carries the Didcot-Oxford line over the river Thames near Culham, was built seventy years ago. It consisted of seven spans of wrought iron girders, carried on cast iron screw piles, and has been replaced by a bridge of modern construction.

Old Hill Tunnel.—This double-line tunnel, 40 chains in length, is between Old Hill and Rowley Regis, on the Stourbridge extension. Five chains in the centre of the tunnel have been reconstructed. The work was the subject of an illustrated article in THE ENGINEER of April 5th last.

Severn Tunnel.—A length of about half a mile is being strengthened by cement grouting. Holes are drilled in the lining of the tunnel and cement, conveyed by flexible piping from plant on the top of the tunnel, through the ventilation shaft, is forced therein under pressure to fill up the voids in the strata surrounding the tunnel lining.

Newport, Mon.—The extensive station improvements here have been referred to in this Annual Article for the last three or four years. The major portion of the work was completed during the year, and it is hoped that the whole will be finished in the coming spring.

Tonteg and Treforest.—The lines between these points that used, before amalgamation with the Great Western, to belong to the Taff Vale and Barry companies, parallel each other. A junction between the two former systems is being put in near Tonteg Junction at the point where the Taff Vale crosses the Barry line. The Taff Vale line from that point to Llantrisant Branch Junction is to be closed. There are goods lines, as well as passenger lines, between Tonteg Junction and Treforest and the goods lines are now to be equipped also for passenger traffic.

Newport Docks.—Two 20-ton hoists have been transferred from the Town Dock, which is being abandoned under parliamentary powers obtained last session, to Alexandra North Dock. The east quay timber stage is being reconstructed in ferro-concrete, with an extensive use of pre-cast members, and the east lock roller bridge is being repaired.

Cardiff Docks.—The West Dock sea gates, which weigh 128 tons, and the upper gates of the inner lock at the East Dock, which weigh 92 tons, have been renewed. The bridge known as the "Camel Bridge," over the inner lock at the East Dock, which was constructed in 1858, has been replaced by a swing bridge, with a swinging weight of 320 tons, over the outer lock.

Penarth Dock and Barry Docks.—The middle gates at Penarth Dock, weighing 200 tons, are being renewed. The middle gates of the deep sea lock at Barry have been replaced.

Swansea Docks.—In connection with the provision of quayage facilities at King's Dock, some concrete columns, 40ft. long by 3ft. 6in. square, and weighing about 50 tons each, had to be removed by blasting. The reinforcing rods were cut under water by special burning apparatus. The pintles of No. 4 east inner gate were renewed. That was done under water in order to reduce, as much as possible, the period of the interference with the lock.

There are now 64 miles of steel sleepers, either laid or actually on order. About 500 miles of track have been relaid or re-sleepered. That has involved the use of something like 37,000 tons of new rail and 750,000 new sleepers, together with the necessary quantities of rail and chair fastenings. These quantities are exclusive of those used in new works, and, moreover, they form part of an ordinary year's programme and are not abnormal. For bridgework and roof coverings, in renewals, 2793 tons of iron and steel work have been, or will be, used. Dredging is a matter of very great importance, and, in order to maintain an adequate depth of water, approximately 3¼ million cubic yards of material were dredged last year from the channels and docks of the Great Western Company's ports.

Southern.

Wimbledon.—The reconstruction of this station, which has been in progress since 1927, was completed. It has five island platforms, of which the two most northern have bay lines which are devoted to the Metropolitan District trains and those of the Southern which travel by East Putney; the next island platform is for main line up trains and the fourth platform is for main line down trains, and the most southern is for the new Holborn–Wimbledon–Sutton–West Croydon service referred to in the next paragraph.

Wimbledon and Sutton Railway.—The first portion of this new line, *i.e.*, between Wimbledon and South Merton, was opened on July 7th, and the remainder on Sunday, January 5th, 1930. The line is provided with stations at Wimbledon Chase, South Merton, Morden South, St. Helier, Sutton Common, and West Sutton, and joins the Central Division Portsmouth main line by a double junction at the west end of Sutton Station. The railway is electrically-operated, and the service is between Holborn Viaduct, Streatham, Tooting Junction, Wimbledon, Sutton, and West Croydon.

Epsom.—A new station, at the junction between the lines from Sutton and Raynes Park respectively, was opened on March 3rd. It has two island platforms and siding accommodation suitable for the reversal of electrically operated trains.

Signalling in the London Bridge Area.—The opening on December 1st of an all-electric power-operated signal-box at North Kent East Junction, certain changes in the signalling at London Bridge Station box and the provision of additional automatic and controlled signalling have allowed the whole of the area between Charing Cross, Cannon-street and London Bridge, on the one side, and Ladywell, Hither Green, Greenwich, and Blackheath, on the other, to be provided with colour light signals.

Lewisham Loops; Kent House and Beckenham Junction Widening.—These works were described in our last Annual Article. The last-named was completed on March 3rd an the former on July 1st.

Newhaven Harbour.—As related herein a year ago, the east pier is being reconstructed in reinforced concrete. The length is 1500ft., and the landward half was completed in the early summer. Work on the seaward portion is now in progress.

Hastings: St. Leonards, West Marina.—The existing station at Hastings is being replaced by a modern structure which will have two island platforms. Towards that end a new locomotive depôt has been provided at St. Leonards, which has allowed the engine sheds at Hastings to be removed in order to make room for the new station there. Additional carriage sidings are being laid down at St. Leonards.

Dover.—A reinforced concrete engine shed, 360ft. long by 107ft. wide, near the Marine Station, was opened and the shed at Dover Priory removed.

Bridges between Faversham and Ramsgate.—Preliminary work for the strengthening of many of these bridges, in order to carry the "King Arthur" class of engine, is in hand.

New Loop at Minster.—This was brought into use on July 8th. It allows direct access from Dover, *viâ* Deal, to Ramsgate and Margate.

Isle of Wight.—The reconstruction of the wharves at St. Helens in reinforced concrete for a length of 800ft. will shortly be completed. A new locomotive depôt is in course of erection at Ryde St. Johns, of which the engine shed and concrete coaling stage have been erected. A new wharf for coal traffic has been constructed at Medina Wharf and the coal transporters will shortly be erected.

Electrification.—The last stage of the conversion from steam operation to electric traction on the Central Section, involving 61¼ track miles, was completed on March 3rd. The replacement of alternating-current operation on the same section by direct-current was finished by September 23rd.

The following further electrification work has been begun, and it is hoped to complete it in Junenext:—Hounslow Junction and Whitton Junction to Windsor, 27½ track miles; Wimbledon and West Croydon, 8¼ track miles; Dartford and Gravesend Central, 14 track miles.

Additional sub-stations, each accommodating two rotary machines, at Ashford (Middlesex), Datchet, and Northfleet, are nearing completion.

An independent goods line is being provided between Beddington Lane and West Croydon.

Mumbles Railway.

The conversion of this 100 years old railway from steam operation to electric traction was completed in February last, and after inspection by the Ministry of Transport, was opened on March 2nd. The line is singular, not only because of its history and that it runs for part of its length along the main highway, but that it is automatically signalled without the use of track circuits and that the facing point locks are actuated by the trains themselves.

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Index to A.S.T.M. Standards and Tentative Standards. Philadelphia, Pa.: The American Society for Testing Materials, 1315, Spruce-street.

Tin: Its Mining, Production, Technology and Applications. By Dr. C. L. Mantell. London: *Colliery Engineering*, 33, Tothill-street, S.W. 1.

Basic Principles of Concrete Making. By F. R. McMillan. London: The McGraw-Hill Publishing Company, Ltd., 6, Bouverie-street, E.C. 4. Price 10s. net.

Coal Washing Investigations: Methods and Tests. By H. F. Yancey and T. Fraser. Washington: Government Printing Office, U.S.A. Price 50 cents net.

Concrete Year Book, 1930. Edited by O. Faber and H. L. Childe. London: Concrete Publications, Ltd., 20, Dartmouth-street, S.W. 1. Price 3s. 6d. net.

Electric Overhead Travelling Crane Design. By W. A. Barson. London: Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. 4. Price 15s. net.

Railway and Seaport Freight Movement. By G. Bulkeley, A.M.I. Mech. E. London: Crosby Lockwood and Son, Stationers' Hall-court, E.C. 4. Price 28s. net.

The Modern Boiler-house. By H. S. Webster, A.M.I.E.E. London: The Draughtsman Publishing Company, Ltd., 96, St. George's-square, S.W. 1. Price 2s. net.

Goodwill in Industry from a New Angle. A Symposium by Five Practical Men. London: The London General Press, 8, Bouverie-street, E.C. 4. Price 2s. net.

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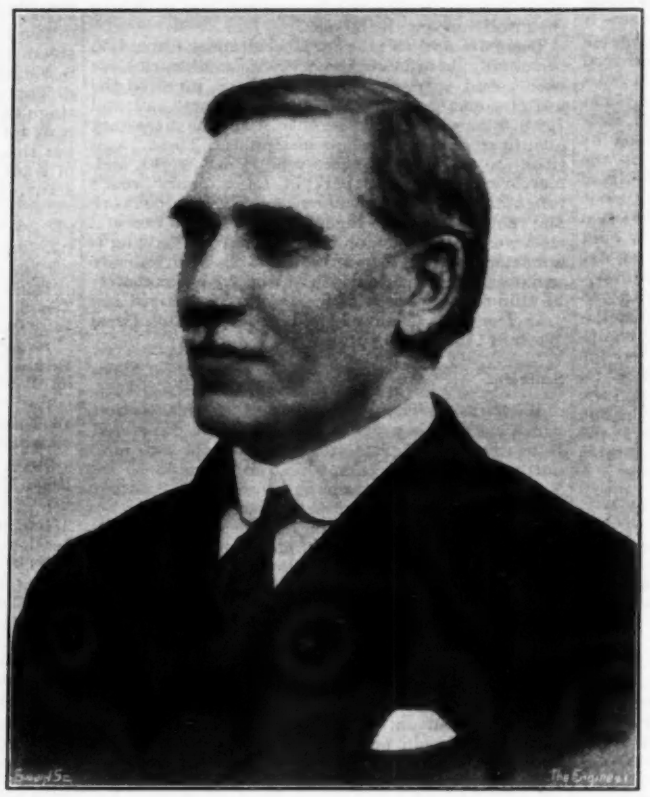
Obituary.

SEBASTIAN ZIANI DE FERRANTI.

A VERY real loss has been suffered by the engineering profession and the world of science alike by the death of Dr. Ferranti, which took place at a nursing home at Zurich on Monday last, January 13th.

Ferranti was essentially a pioneer; just as much a pioneer as were those who sailed across uncharted seas in the search of new lands in centuries gone by, and just as were the Empire Builders of more modern times. He foresaw, when little more than a lad—as, possibly, no other men of the time had foreseen—the enormous possibilities of the new form of energy which had not long been put to practical use in the form of light giver. He visualised, in the 'eighties of last century, the founding of large electric generating stations, erected far from crowded centres of population, transmitting current cheaply at extra high pressure to those centres, so that residential districts, while being able to avail themselves of the new illuminant, might be free from the dirt nuisance and noise which, inevitably, accompany the operation of steam-worked machinery. He saw how it could be done, and he set out to do it, undaunted by the colossal obstacles lying in his path, some of which he foresaw and many others which he suspected might be encountered. What he proposed to do had never been done before; he had nothing to guide him, but with a courage which cannot fail to awaken astonishment and admiration he embarked on a project which many, who were regarded as most competent to judge, declared to be impossible of achievement. That he did not accomplish all he set out to perform was due to no fault of his. Legislation circumscribed his activities by permitting the erection of small generating stations by local authorities and others serving comparatively small districts all over the wide area which he proposed to supply, so that the large central station which he had planned to the very last detail never really had an opportunity of showing what it could do. An absolute essential for the complete success of such an undertaking as that on which he embarked at Deptford, was that operations should be on a large scale; yet though he was prepared in every way to do so, Ferranti never got a real chance to carry his ideas to their full fruition. Like so many other pioneers, he was to live to see others, taking advantage of the pathway he had hewn through the jungles of inexperience, pass along the track he was the first to form, and reach the goal, the existence of which he had clearly seen from the outset. Ferranti could well have claimed to be the originator of long-distance electric transmission. That he had envisaged the employment of far higher pressures than the 10,000 volts which he chose for the transmission between Deptford and the Grosvenor Gallery, there is good reason to suspect, but, as we shall show, he was hampered by the inability of the cables made at the time to withstand the stresses set up by high-tension alternating currents. He had even to invent, himself, a method of making cables which would successfully work at 10,000 volts.



SEBASTIAN ZIANI DE FERRANTI

Sebastian Ziani de Ferranti was born in Liverpool on April 9th, 1864, so that he was only in his sixty-sixth year at the time of his death. It was not easy, at any time of his life, however, to realise how old he really was. Well on into middle age he had a quite youthful look. It is said of him that the blood of four nations ran in his veins—American, English, Flemish and Italian. If that were so, then the blend produced an intellect of high quality and capacity. He received his early education first at Hampstead School and then at St. Augustine's College, at Ramsgate. His stay there was marked by two events. He finished the construction of a small dynamo, and he very nearly blinded himself. As many a youngster before him, and since, has found when seeking to cast lead bullets for catapults, molten metal is liable to spurt out of a wet mould. Young Ferranti was not casting bullets; he was trying to join together two pieces of a battery carbon by means of a lead bond, but he had omitted to dry them, with the result that the metal flew up against his face and very nearly caused irreparable damage. Of practical training, as we now know it, he had almost none, though for some time he attended at University College in Gower-street, where he was fortunate in coming in contact with such brilliant scientists and teachers as Sir Oliver Lodge and Professor Carey Foster. Exactly how long he remained under this influence we do not know, but it could not have exceeded eighteen months or so, for he was still at Ramsgate when he was fifteen, and in 1881, when he was seventeen, he was given a post in the works of Siemens Brothers at Woolwich. There he worked as assistant to the late Sir William Siemens, who was at that time engaged in experimental work in connection with an electric furnace for the manufacture of steel. While there, his inventive genius had full chance of development. He designed a method of imparting motion to the molten metal in the furnace by induction, and it is said that he succeeded in obtaining metallic tungsten. Very soon afterwards—that is to say, in 1882—he invented and patented an alternating-current generator with disc-wound coils revolving between the poles of two sets of electro-magnets arranged round the periphery. The machine at one time enjoyed a considerable vogue.

In the early 'eighties there was a good deal of activity in the installation of electric incandescent lamps in houses. The wonderful exhibition at the Crystal Palace in 1882 had shown Londoners what really astonishing things had, even at that early date, been done with this, then novel, system of illumination. In 1883 Lord Crawford, who was always interested in scientific matters, and Sir Coutts Lindsay determined to install electric light at the Grosvenor Gallery in Bond-street, London. They accordingly laid down a small generating plant in a yard behind that building. The venture was at first a success, and owners of houses in the neighbourhood made eager application to be supplied with current. The capacity of the plant was accordingly increased, and things still went well for a time, but eventually troubles were experienced, and in 1886 Ferranti was called in to put things right. Thus began his direct connection with the distribution of electrical energy, to which he was destined to devote so much attention in after life.

Very soon he effected an amelioration. He largely increased the capacity of the plant and gradually he widened the area over which electricity was supplied until, finally, a very large portion of the area of London north of the Thames was covered. To use his own words:—"We went with our mains from the River as far north as Hampstead. We went eastward as far as the City, which we were barred from entering, and well into Chelsea." All this was done by means of overhead circuits—there were five of them, we believe—and the voltage employed was 2500. When a consumer desired to have a supply, a transformer was put into his house.

Experience at Grosvenor Gallery proved to Ferranti, however, how very inconvenient it was, from many points of view, to have electric generating stations in crowded areas. And then the idea of having a generating station far from the point where the energy was to be used, which had for long been germinating in his brain, took definite shape in the proposal to build a high-pressure station at Deptford. There, on a site adjoining the river Thames, remote from the centre of the City, in a neighbourhood in which the production of noise and dirt would be incomparably less objectionable than it would be in a crowded residential district, could, he argued, be erected a powerful station which, by means of high-tension transmission, would be capable of furnishing current over a much wider area than was possible from a small plant in a yard behind a building in one of the narrowest main thoroughfares in the Metropolis. And the cost of generating the energy would be so much less, too! Could not sea-borne coal be received at the station wharf from colliers coming from the northern counties? And was there not ready to hand condensing water in the river in almost unlimited quantities? And could not large machinery operate much more efficiently than small?

Thus the Deptford project was definitely launched. This is not the place nor have we the space to trace its history in detail, nor to follow it through all its vicissitudes. It must suffice to refer to it very briefly, but before we do so it must be related that the melancholy fact that it was doomed to failure was borne in upon its founder or ever it was got to work. "The failure of Deptford was," wrote Dr. Ferranti, in a note we received as recently as December last, "settled before it started, at the General Inquiry held in London for fixing areas of supply, which was presided over by Major Marindin. I had planned out that the London Electric Supply Corporation should operate over the whole of the north side of the River. The station was only placed at Deptford so as to be in what I considered the nearest available position for satisfactorily giving this supply. . . . I had . . . definitely covered the ground (*i.e.*, from Grosvenor Gallery) when we were working without parliamentary powers, in the hope that this area could eventually be retained by us in much the same way as the area was operated by the Gas Light and Coke Company. Unfortunately, failure to maintain our position at the Government Inquiry entirely killed the scheme. Our area was very greatly reduced, but worse than this, we had competition from local stations arranged for in every part of our area. We were given a considerable area south of the Thames, but in those days this was very little use to us from a business point of view. Naturally, with a new system on the scale on which we were operating, it was very difficult to compete right away with small low-tension stations dotted all over our area, as, of course, we had great technical difficulties to deal with at the start, and the small low-tension direct-current stations had very little new to contend with. It is easy to see under the circumstances why the scheme did not succeed as it should have done."

It is not difficult to imagine the intense disappointment this must have been to Ferranti. The disappointment must have been all the more galling in that, not so very long afterwards, all the in-town stations were, from one cause or another, in such trouble that they would have welcomed a supply from outside. Had Deptford been completed on its original designs, it would have been able to furnish current wholesale for distribution by other companies. But it was not, and it lost the chance planned for it by its designer. However, in spite of the setback, Ferranti, with magnificant grit and courage, persevered with his scheme, notwithstanding its curtailed scope. The whole original design of the station had to be departed from, and, in his own view, it was practically spoilt by the plant additions that were made. He had intended to lay down four engines, each of 10,000 horse-power—a size unthought of for electric generating machines before he suggested it. They were to drive alternators which were to generate current at from 10,000 to 11,000 volts. They were huge machines. The fly-wheel rim which formed the armature support, and was made of cast iron, was 34ft. in diameter, while the magnet frame was 40ft. in diameter. The engines were built but they were never finally erected on the site. It is of interest to note that in the works of Hick, Hargreaves who constructed them, they had to be erected lying down, as there were no shops available for building engines of such size in their natural positions. They had two high-pressure cylinders, each 44in. in diameter, and two low-pressure cylinders, each 88in. in diameter, and the

piston speed was 750ft. per minute, the steam pressure being 200 lb. per square inch. They were designed, as was everything else in the station, including the various alternators, transformers, switchgear, and all the equipment, but with the solitary exception of the roof, by Ferranti. Instead, however, of four 10,000 H.P. engines, the plant in operation when the station was opened in 1890 consisted of two 1250 H.P. engines, which, it may be remarked incidentally, were frequently worked up to 1800 H.P.

Nevertheless, although the station was not completed as designed, it yet had some most interesting and original features. In the first place, it was built on one single block of concrete, and was one of the first of its kind to be so constructed. Over the whole area on which the station was built was laid a raft of concrete, which was made 5ft. thick where the 10,000 H.P. engines were intended to come, and 4ft. thick under the smaller engine-house and the boiler-house. The walls were built directly on the concrete without footings. The cast iron columns for the floor and roof were stood upon this concrete block, and the foundations for the engines were started on the block and taken up to floor level. The 1250 H.P. engines, which were of the Corliss type and were also built by Hick, Hargreaves, drove their alternators by means of cotton ropes, forty to each machine. At first there was trouble with hot crank pins and hot main bearings, and, in order to get over the difficulty, Ferranti designed and had fitted swivel crank pin bearings to the first of the engines. He also designed and had built into the 1250 H.P. engines main swivel bearings, and no further difficulty with hot bearings was experienced. Ferranti believed that that was the first occasion on which very large engine bearings were made of the swivelling type.

Writing to us of the alternators driven by the Corliss engines, Dr. Ferranti said recently: "An extension of the pulley at the far end carried the armature. Bare copper bobbins riveted into bronze holders were carried from heavy rectangular nuts fixed in the pulley by means of sulphur compound run in. Holes were formed in the pulley for the shanks of the bobbin holders, which were screwed into the nuts. In this way we had a number of pairs of bobbins, each one separately insulated from the main frame of the machine. This is how we managed to build a 10,000-volt machine without any of the insulating materials as known to-day." The engines were to stand on the alternator base-plates, which were manufactured at Deptford. In order to carry out that work, some very large machine tools—made by Shanks, of Johnstone—were installed in one of the big bays. All the parts for the alternators and their base-plates were machined by this plant under his direction.

The boiler-house was arranged with two storeys, with ash removal arrangements below and coal storage above. There were two chimneys, each with four separate flues, so that actually there were eight separate units of boilers, and any one unit with its economiser, chimney, and blowing fans, could be separately laid off for overhaul and maintenance repairs. So far as Ferranti was aware, the two-storey boiler-house was a novelty. At any rate, he believed that it was.

The switchgear was of the cellular type. All the parts were interchangeable, and as the bus-bars were arranged on the principle of a ring main, any part could be made dead for cleaning or repairs.

Many troubles were met with when the time came to test the transmission of energy at a pressure of 10,000 volts. Cable breakdowns were numerous and voltage surges when switching on, which had not been fully anticipated, were experienced, but were surmounted by what were actually extremely simple means. The cable difficulty was, however, not so easily overcome, and eventually Ferranti had to design machines for the purpose of manufacturing, and actually to make his own cables, using for insulation paper tape impregnated, we believe, with ozokerit. The cables thus produced served their purpose, and served it well, though they could only be made in 20ft. lengths. There were, consequently, some 7000 joints in the 28 miles or so of cable that were laid, but some of it did good service for thirty-five years.

In short, Deptford, though far from being what it was intended to be, played its part. "The system," to quote Dr. Ferranti's own words, "demonstrated the feasibility of making the high-pressure current at a distance from the area of supply, its transmission to that area at what was then very high pressure, its transformation down to a lower pressure of distribution at a number of points in the area, and the final supply of low-tension current within the area. All these things were successfully accomplished in practice, and a good service was given to the public."

Before we leave the Deptford Station, it is worth putting on record that, in order to utilise the 2500-volt alternators which had been in operation at Grosvenor Gallery, they were transferred to the former station, as were also the transformers which had been used to step-down the 10,000-volt current coming from Deptford to 2500 volts. The latter were then employed to step-up the 2500 volts of the generators to the 10,000 volts necessary for transmission. This point is strongly reminiscent of present-day usage, as it is the standard practice of operation nowadays for all high-tension work, the difference being that the generation voltage is from 6000 to 11,000 volts and the step is to the highest figure now worked. The machines and transformers mentioned were also built to Ferranti's designs.

In 1892 Ferranti resigned from the Engineership of the London Electric Supply Corporation and became a manufacturer, founding the business which is known at present as Ferranti Ltd., with works at Hollinwood, where transformers and measuring instruments made to Ferranti's designs are now produced. There he built engines and electrical machinery and apparatus of various kinds, including his famous meter. On this aspect of his activities we do not propose to dwell at any length, but it may be said that the products of the firm enjoyed, and still enjoy, a well-merited reputation. It may be mentioned, too, that he carried out the reconstruction of the alternators and switchgear at the Bankside Station of the City of London Electric Lighting Company.

In 1910 and 1911, Dr. Ferranti was president of the Institution of Electrical Engineers. His presidential address, which was entitled "Coal Conservation, Home-grown Food and Better Utilisation of our Labour," attracted a great deal of attention at the time. He maintained that, while we could never hope to get anything like the full value of the energy latent in coal, the throwing away of 90 per cent. of it, as was customary, was of the greatest possible concern to the country. He stated that apart from about 2,000,000 tons used in coasting steamers and 15,000,000 tons converted into gas, some 150,000,000 tons were being used in this country per annum. Under the then existing conditions, that 150,000,000 tons would produce 131,400 million Board of Trade Units. He believed, he said, that, in course of time, the steam-gas turbine, in which highly superheated steam was used in a state of gas, would effect such an increase in plant efficiency that the 131,400 million Board of Trade Units would be produced for an expenditure of 60 million tons of coal instead of 150 million. He believed, too, he said, that, with everything operated by electricity, a power factor of 60 per cent. could be looked for with a proper distribution of power stations. 131,400 million B.Th.U. at 60 per cent. load factor would require the installation of 25 million kilowatts of plant, and he suggested the laying down of, say, a hundred stations, each of 250,000 kilowatts capacity, and each containing ten generators each of, say, 25,000-kilowatt capacity. In other words, he proposed very nearly the same thing that is actually now being attempted by means of the "grid." Incidentally, the fertilisers produced by the scientific treatment of coal, would, in his vision, enable the whole of the corn requirements of the country to be satisfied if only 3½ million more acres than were at the time in cultivation were to be put under crops. It was a vision which has not yet been fulfilled, but who shall say that it is impossible of substantiation?

Dr. Ferranti had the distinction of being awarded the Faraday Medal of the Institution.

At the Jubilee Commemoration Meetings of the Institution which were held in February, 1922, Dr. Ferranti gave some most interesting particulars of his first experiences with science, electricity and magnetism. The first book which he studied as, he said, Professor Pepper's "Playbook of Science," which was given to him as a birthday present when he was eleven years old. Then there was Ganot's "Physics," and from these two volumes, he said, "I think I obtained most of my technical knowledge." Then he told how, with a battery of six bichromate cells, which he had somehow or other contrived to put together, and two lead pencils, he managed to produce "the first small electric light that I was privileged to see. I need not say how much I thought of my first tiny electric light." Then, he was lucky enough to meet a man who had made a dynamo. The machine had a shuttle-wound Siemens armature with a two-part commutator furnishing uni-directional current. "There was nothing sensational about it, yet I cannot say how greatly it inspired me." So he set about to make a machine of his own, and his great aim was to improve on the machine he had seen. "I knew about the Gramme machine," he said, "although I had never seen one. I did not know about Paccinotti, but I evolved, practically speaking, a Paccinotti machine, after a great deal of trouble, and after a great many delays, on account of the absorption of money caused in the process. However, the machine worked very well when I was able to drive it; and later on, the sale of this small machine when I had come on hard times, tided me over until I was able to start earning for myself." Doubtless, this was the machine the construction of which he completed while at Ramsgate.

Some of the most interesting and valuable work carried out by Ferranti, apart from electrical matters, was his investigation into the behaviour of steam under various conditions. He did an immense amount of inquiry in this direction, and the results he achieved have been of great service. In this connection, we may quote a passage from the James Watt Lecture which he delivered before the James Watt Club on January 16th, 1913:—"The subject of prime movers is one in which I have always been most interested, and in following it my constant aim has been to increase the amount of work that can be usefully obtained from a given amount of fuel. It is, of course, well known that the higher the temperature of the working fluid the higher is the economy that can be obtained. High temperatures have, however, proved very difficult to work with, and as an instance of this the low working temperatures of turbines for marine propulsion may be pointed out. Seeing, however, that the difficulties were mechanical, and that great advantage could be derived if these troubles were overcome, I commenced experimenting some years ago, and have now, after many failures, and the expenditure of much money and time, produced a turbine which at the highest temperatures and with great and rapid variations of temperature is quite free from mechanical troubles. Indeed, I believe that this turbine is, perhaps, the strongest from a mechanical point of view that has yet been produced. Moreover, contrary to what might have been expected with a high temperature machine, it runs with certainty with a blade end clearance that is so small that it is almost negligible from the point of view of leakage loss, and the fear of the possibility of stripping appears to have been effectively removed. In this turbine I superheat the steam initially, and after the first expansion, and whilst it is still superheated, re-superheat it before it does its work in the second stage of the turbine. After this it is exhausted in a superheated condition through a regenerator to the condenser. The whole of the blading is electrically welded so as to avoid the straining due to caulking at the high temperatures that are reached, and also the loosening that occurs due to the same cause. The blading is formed of mild steel, with a thin coating of pure sheet nickel electrically welded on to the surface. The blading is most accurately finished to shape by a process of step-by-step pressing under very heavy pressure. The blading, the sections of which are very exact, is welded in position with the accuracy of the automatic machine that is used for the purpose, and every opportunity is thus given for realising the best results. Although the turbine is of the reaction type no balance dummy is used. The whole of the end load is taken on a specially constructed thrust, thus saving steam leakage. The steam is worked as a gas at high temperature throughout the turbine, and this, coupled with the many improvements above referred to, has given very good results.

"The 5000 horse-power machine, which has now been running for some time, when tested at a load of two thirds full power, has given a shaft horse power on 7 lb. of steam, which, if supplied by an oil-fired boiler superheater system of 85 per cent. efficiency, which has already been exceeded in central station practice, would consume less than 0·625 lb. of oil per shaft horse-power. From many tests already made it appears that when this turbine is run at full load under favourable conditions, it will take less than 6 lb. of steam per shaft horse-power, and that the system under the conditions named will have a thermal efficiency of over 24 per cent., corresponding to an oil consumption of about 0·55 lb. of oil per shaft horse-power."

In the foregoing necessarily brief account of the life of a very eminent man, from which much that he did has had, perforce, to be omitted, three only of his activities—electric supply, the manufacture of electrical machinery, and the study of steam—have received mention. In reality, Ferranti's attention was directed into very many and varied channels, and in whichever way he turned, he did good—in some cases most valuable—work. Between the years 1882 and 1927 no less than 176 patents were taken out by him, only five of them being in conjunction with another. One of those five was for a "Dynamo-electric machine," which was taken out in 1884, and the other name on the specification is that of Sir Wm. Thomson—afterwards Lord Kelvin. In 1884, it may be said, Ferranti was just twenty years of age, and he must have felt it a great honour to have his name joined with that of such a shining light as Sir Wm. Thomson. Apart from things electric—and he covered every branch of electrical matters—Ferranti's patents were of such widely diversified things and subjects as:—Vacuum pumps; spectacle frames; steam engines; non-return valves and stop cocks; corrugated tubes; white lead and chrome pigments; presses for lead pipes; toothed and friction gearing; roller and ball bearings; driving bands for bicycles; water turbines; supporting high-speed rotating bodies; engine condensers; heat engines; steam turbines; spinning machinery; motor and machinery balancing devices; securing turbine blades; vehicle wheels; metallurgical processes; conducting gaseous endothermic reactions; heat-measuring device; pipe line compensating devices; tires; compound metals; carburetters; imparting stability to bodies; treating fibrous materials; thrust bearings; shaft packings; steam superheating; pumps; projectiles; shell forging; means of preventing damage to tires; steam boilers; steam power installations; protection of metals; loud speakers; index pointers; meter indicator mechanism, &c. It is a matter to marvel at that one brain could, in the course of a lifetime, devote serious attention to such a bewildering variety of subjects.

As a man, Dr. Ferranti was possessed of a charming personality, which endeared him to everyone with whom he came into contact. It is extremely doubtful whether he made an enemy in the whole course of his life.

Those devoted colleagues who helped him to perform such wonders as were wrought at the Deptford Station under such adverse and—it must be admitted—at times depressing circumstances, had for him an affection which continued till his death.

Dr. Ferranti had for many years been a member of the Institutions of Civil and Mechanical Engineers, and in 1911 had conferred on him by Manchester University the honorary degree of D.Sc. He was elected a Fellow of the Royal Society in 1927.

PROFESSOR AUGUSTE RATEAU.

BRITISH engineers, no less than those of France and the Continent, will have learned with great regret of the death of Professor Auguste C. E. Rateau, which took place in Paris on Monday last, January 13th, following an operation in the preceding week.

Professor Rateau was born on October 13th, 1863, at Royan, a small town near to the mouth of the river Gironde. His early education was received at the grammar school at Cognac, a town not far distant from his birthplace. In 1881 he proceeded to Paris, and entered the Ecole Polytechnique, rapidly becoming the head of his year. In 1883 he left for the Ecole Superior des Mines, at which in 1886 he gained the degree of Inspector of Mines. His first appointment was that of mine inspector in the district of Rodez. In 1888 he was appointed Professor of Mining at St. Etienne, and continued to hold that Chair until 1898, when he became Professor of Industrial Electrical Engineering at the School of Mines in Paris. While he was a student he began a series of papers which were published at short intervals, in which he dealt with such varied aspects of engineering science as mechanics, head pumps, springs, transmission, dynamometers, turbines, and fans. He was associated with the firm of Sauter, Harlè and Co. in Paris, in the working out of his earlier fan and turbine designs, and in 1903 he founded the Société Rateau, which from small beginnings rapidly grew into a large undertaking, employing some 3000 workmen, with branches in all European countries.

His early work on mine ventilation laid the foundations for the later development of the turbine and the turbo-blower. At first, Professor Rateau constructed single-stage turbines, but in 1897 he built a multi-stage turbine with two impulse wheels working in series. It was at the World Exhibition in Paris in 1900 that he exhibited the first set of drawings and some parts of a 1000 S.H.P. multi-stage turbine, which was designed for a French torpedo destroyer. A full account of the marine application of the Rateau turbine will be found in the paper on "The Rational Application of Turbines to the Propulsion of Warships," which he read at the Jubilee Meetings of the Institution of Naval Architects in 1911.

Following his work on high-pressure condensing turbines, Professor Rateau attacked the problem of the low-pressure exhaust turbine, and its use in connection with the reciprocating engines of colliery winding plants. In order to overcome the discontinuous supply of low-pressure steam in such an installation, he invented the steam accumulator which bears his name. In 1902 he delivered a lecture on "The Utilisation of Exhaust Steam by Steam Accumulators and Condensing Turbines," before the Institution of Mining Engineers at Newcastle-upon-Tyne, in which this subject is dealt with. Work in the same field included that on the air ejector for condensers and surface condenser design.

The early research work which Professor Rateau carried out in connection with ventilating fans led subsequently to the design of the multi-stage high-speed turbo-compressor, which found wide use in the mining, iron and steel, chemical, and other industries. This development was followed up by improvements in impeller construction, which enabled, with solid steel impellers, enormous peripheral speeds, up to 1640ft. per second, to be obtained with a compression ratio of more than three. The later designs opened up two fields of application, namely, the supercharging of aero engines and marine oil engines. During the war Professor Rateau, in collaboration with Messieurs Farman, produced a new type of gas turbine driven geared supercharging compressor, with a clutch which could be disengaged or engaged while the machine was in flight. An interesting account of this work will be found in his lecture given before the Institution of Mechanical Engineers in June, 1922, on "The Use of the Turbo-compressor for Attaining the Greatest Speeds in Aviation." For this lecture, Professor Rateau was awarded the Thomas Hawksley Gold Medal by the Institution.

At the beginning of the war Professor Rateau, although over the military age, took the field, and only returned to direct his own works and the manufacture of munitions at the request of the French Government. He was the recipient of many honours, both in his own country and abroad. In 1923 he was made a Commander of the Legion of Honour, and he bears the distinction of being the second French engineer to become a member of the French Academy of Science. His work was recognised abroad by the conferring of the degrees of Doctor of Science and of Laws at the universities of Birmingham, Charlottenburg, Louvain, and Wisconsin, and his technical papers are to be found in the "Proceedings" of the scientific and engineering institutions of many countries.

Few men have exercised such a widespread influence on engineering design, and the loss of Professor Rateau will be keenly felt by his many friends, his own firm, and all who were interested in his work.

A Large Electric Winder.

AT the number four shaft of City Deep, Ltd., on the Witwatersrand section of the Rand Goldfield, the largest electric winder so far built has recently been put into service. Its direct-current motor—which is to be seen in Figs. 1 and 2, on page 78—is rated at 5000 horse-power and 12,500 horse-power on the maximum peak load. On account of its slow speed, the dimensions of the machine are greater than those of any other motor designed for winding service. The drums and some other parts of the equipment are also exceptionally large, and for various reasons it seems improbable that an electric winder of greater power or larger size will be built anywhere for some years to come. With its sub-shaft 4A, the City Deep No. 4 shaft constitutes a vertical sinking of a total depth of approximately 7000ft., which is within a few hundred

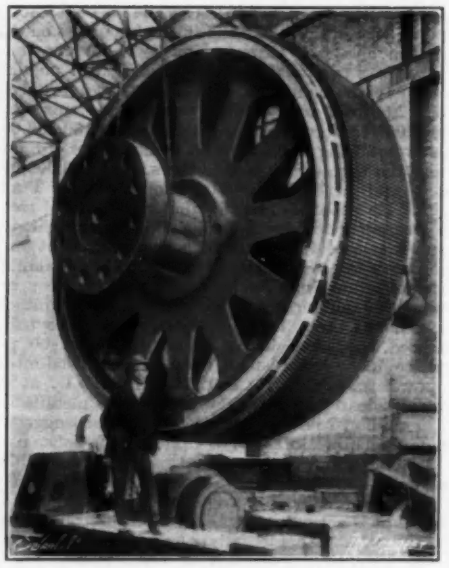


FIG. 5—ARMATURE

feet of the deepest sinking in the world. As is customary with mines of very great depths, the winding is done in two stages, by two separate winders. The ore is brought up from the workings to the 4500ft. level by an electric winder installed at the top of the No. 4A shaft at that level, and the load is there transferred to the No. 4 winder, which brings the load to the surface. The duty required of both shafts is 3000 tons of ore per twenty-four hours to be handled in twelve hours, plus all men and materials necessary for this output during the other part of the day. Both shafts are 20ft. in diameter in the clear, and are equipped with double deck cages.

In the case of the No. 4 shaft, the cage dimensions are 14ft. 8in. by 5ft., and the weight of the cage is 16,370 lb. The ore is carried in a single truck on the lower deck; the man load is 55 per deck. The trucks are of 7000 lb. tare weight and of 16,000 lb. rock capacity, which, with the normal allowance of 30 per cent. moisture, gives a net load of 20,800 lb., or about 9¼ tons. The winding ropes are 2½in. in diameter, with triangular strand, Lang's lay, with six steel strands, and a hard manilla core. The braking stress is 250 tons, and the weight is 8·917 lb. per foot. The rope fully extended adds, with balanced cages, about 18 tons to the net load at the beginning of a wind, giving a total initial load of over 27 tons. With unbalanced winding the total initial load of ore, cage, truck and ropes amounts to approximately 38 tons. A direct-coupled direct-current equipment, with Ward-Leonard control, having double loose bi-cylindro-conical drums 17ft. 6in. over the small diameter and 35ft. on the large diameter, has been provided. The full speed of the motor, which is composed of two units solidly coupled to either end of the drum shaft, is 32·7 revolutions per minute, corresponding to a rope speed of 3600ft. per minute on the large diameter of the cast steel drums, which weigh 350 tons. The 17ft. 6in. diameter cylindrical portion was cast in two parts, whilst the conical portion and the 35ft. diameter cylindrical portion and the outer sections of the large spider were cast in eight sections, the rope tread sections being arranged to break joint with the spider sections. The brake spider was cast in halves, and the brake tread, which is 21ft. in diameter and 2ft. 1½in. wide, was also cast in sections. On the small cylinder the rope tread consists of twelve turns; on the cone 9¼ turns, and on the large cylinder 19 turns, with 12·72 turns of rope as a second layer on this portion to give the necessary winding length.

On page 78 we give views—in Figs. 3 and 4—of the equipment in the course of construction, and from these illustrations some idea of its massive proportions can be gained. The complete winder shaft is 84ft. 6in. long, and weighs 100 tons. It is in three parts, with the drum portion in the centre, and a motor portion coupled at each end. The drum portion is 47ft. 8in. long, its diameter varies from 34in. to 39in., and it has a central hole 18in. in diameter. It weighs 59 tons. Each motor portion of the shaft is 18ft. 5in. long; the diameter varies from 22in. to 33in. and has a hole 6in. in diameter. The weight of each motor portion is 21 tons, and they are coupled to the drum shaft by flanges with twelve bolts fitted, 5¼in. in diameter on a 45in. pitch circle. Under working conditions the drum shaft is stressed to a maximum of approximately 5000 lb. per square inch. All the bearings are of the ring oiled spherical seating two-part type divided across the horizontal diameter and connections are provided for a pressure oil supply if it should be required. The maximum pressure at the centre bearing is less than 300 lb. per square inch. The cast steel clutches, which have 56 teeth on a 110in. pitch circle, give a rope adjustment of almost 24in. per tooth. Each clutch is operated by an air engine. The brakes are of the usual curved pattern. Brake posts are suspended above the centre line of the drum with wood blocks, having an arc of contact on each post of 90 deg. and a width of 25in. Under normal working conditions the pressure between the block and tread is below 50 lb. per square inch. The brakes are moved into the on position by the usual dead weight and air if required, with multiple leverage, and each pair of post brakes is kept in the off position by an air brake engine, which lifts the weight at a pressure of 40 lb. Air for operating the brake and clutch engines is provided by a vertical two-crank compressor driven through gearing by a 32 horse-power motor. An automatic unloading device on the suction side of the compressor closes when the air pressure reaches 105 lb. pressure, and opens when the pressure falls to 100 lb. per square inch. Depth indicators of the post-type are mounted on the driver's platform and are driven from the drums by machine cut gearing, which gives a travel of approximately 2in. to the pointer for each revolution of the drums. The gear on the drums also drives a tachograph, which has a large dial calibrated in feet per minute for indicating the speed of the large diameter of the drums.

As already indicated, the winding motor consists of two units on either side of the drum. Each unit is designed for a normal output of 2500 horse-power at a speed of 32·7 revolutions per minute, at a pressure of 550 volts. The two units are operated in series on a 1100-volt supply from a motor generator set and are controlled as a single motor on the Ward-Leonard system, the speed of the motor being controlled by variation of the generator voltage by means of a controller in the generator field circuit. A 220-volt exciter motor generator set provides the excitation for the winder generator and motor units, which are open-type machines with commutating poles. The overall diameter of each machine is 19ft. 3in., and when completely assembled on the shaft the weight is 148 tons. There are twenty-four main laminated poles, the interpoles being composed of cast steel. The armature of each unit—Fig. 5—is 13ft. 6in. in diameter, and without the shaft it weighs 48 tons. The motor generator set, which has a synchronous speed of 500 revolutions per minute and full load speed of 490 revolutions per minute, consists of a 5200 horse-power induction motor coupled to two 1950-kilowatt, 550-volt, direct-current generators, and a 46-kilowatt, 220-volt exciter, which, as already mentioned, serves for exciting both the generators and the winder motor units. Although the 50-cycle induction motor is designed for a normal working pressure of 2000 volts, it is capable of working at a pressure varying from 1900 to 2300 volts, and with a frequency ranging from 48 to 52 cycles without exceeding its permissible temperature rise of 35 deg. Cent., with the surrounding air at a temperature of 35 deg. Cent. The direct-current generators on each side of the induction motor are shunt-wound, compensated, interpolar, open-type, self-ventilated machines, with the armatures and commutators constructed on similar lines to those of the winder motor units. The generator set is equipped with a tachometer, speed indicating magneto and centrifugal overspeed switch.

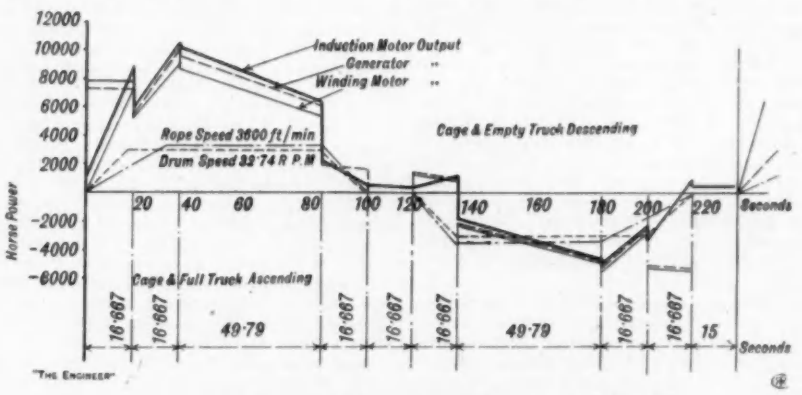


FIG. 6—HORSE-POWER SPEED-TIME DIAGRAM OF WINDER

Normal horse-power speed-time diagram for balanced

and unbalanced winding are shown in Figs. 6 and 7 respectively. The maximum peak load which occurs in unbalanced winding is 9000 horse-power, but the motors are capable of dealing with a peak load of 12,500 horse-power. The following table gives the main technical data of the equipment, the efficiencies shown being those guaranteed by the makers. In the diagram, Fig. 8, the guaranteed efficiencies of the motor generator set are all shown in comparison with those assumed in the initial calculations for determining the theoretical power requirements and also in comparison with the actual efficiencies obtained on test at the maker's works.

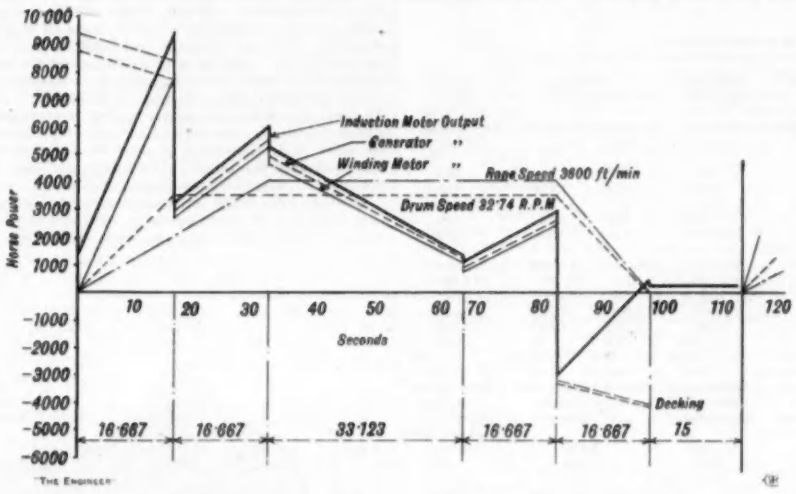


FIG. 7—HORSE-POWER SPEED-TIME DIAGRAM OF WINDER

Winder Motor.

R.M.S. rating	5,000 H.P.
Maximum peak rating	12,500 H.P.
Speed	32·7 r.p.m.
Weight of rotating parts	96 tons
Moment of inertia	248,000 lb. ft.²/g.
Peak current	6800 amps.
Brush contact area, each unit	90 sq. in.
Efficiencies—	
Load: Half	93·25 per cent.
Three-quarter	94 "
Full	94·25 "
1¼	93·75 "
Double	92·5 "
2½	91·5 "

Motor Generator Set.

Induction motor rating	5,200 H.P.
Generators' rating	2 × 1950 kW
Speed at full load	490 r.p.m.
Weight of rotating parts	45 tons
Moment of inertia	354,000 lb. ft.²/g.
Full load rotor current	2,000 amps.
Open circuit standstill voltage of rotor	1,100
Efficiencies: Motor—	
Load: Half	94·5 per cent.
Three-quarter	95·5 "
Full	96 "
1¼	96 "
Double	96 "
2½	95 "
Efficiencies: Generators—	
Load: Half	91 per cent.
Three-quarter	93·25 "
Full	94·25 "
1¼	94·5 "
Double	94·25 "
2½	93·75 "

Mechanical Equipment.

Drum, double, bi-cylindro-conical—	
Large diameter	35ft.
Small diameter	17ft. 6in.
Moment of inertia	3,330,000 lb. ft.²/g.
Total rotating weight, including shaft and armature	562 tons
Brake paths	21ft. diam. by 25½in. wide

The difference between the assumed and guaranteed efficiencies is small, and as usual in these cases it is slightly on the right side. The efficiencies obtained in the tests exceeded those guaranteed. On account of their large size, it was not possible conveniently to assemble the winder motor units for testing purposes in this country, but it is hoped that the results of the tests on site will shortly be available. The supply of power to the motor generator set is controlled by means of a cubicle-mounted oil circuit breaker, with automatic overload, and no-volt devices in the 2000 line to the induction motor, in conjunction with a hand-operated liquid starter in the rotor circuit, the two units being electrically interlocked, so as to ensure that the starter is in the off position and that the short-circuiting switch is open before the main circuit breaker can be closed. The principal item of interest in connection with the control apparatus, however, is the control gear and protective equipment for the winder motor and the general winding system. The winder is controlled on the Ward-Leonard system by means of a reversing controller connected in the field circuit of the generators and operated from the driver's platform, the controller being of the face-plate type, with a large number of steps, by means of which extremely fine adjustment of the generator voltage and therefore of the winder speed can be simply and quickly obtained in either direction. With equal facility braking can be effected electrically on the regenerative principle, the stored energy of the moving parts being transferred to the converter set by reversing the functions of the motors and generators, thus returning power to the supply system. It is well known that this method of control is extensively adopted for large motor installations, such as electric winders and rolling mills; its somewhat higher initial cost over the direct control of direct-current or alternating-current motors being offset by its greater economy in operation, owing to the elimination of rheostatic losses, regenerative properties and smoothness and flexibility of control. For very large jobs, such as that under consideration, the Ward-Leonard method has great advantages. For large installations direct control is impracticable, owing to the extremely heavy currents to be dealt with and the excessive energy dissipation that would be necessary.

Auxiliary contact rings and studs are provided on the controller for the operating circuits of creepage prevention and field cooling devices and for interlocks. The creepage prevention contacts complete the circuit of contactors, which complete the generator field circuit in the reverse direction through the generator armature, thus neutralising any small voltage due to residual magnetism of the field and ensuring that the winder remains stationary when the controller is set to the off position. Similarly, the field cooling device contacts operate a contactor which inserts a resistance in the field circuits when the motor is brought to rest and when it is therefore deprived of the cooling produced by windage. The resistance reduces the field current to about two-thirds of its normal value, which corresponds to the normal heating effect when running; but the working of the field is not sufficient to retard to any appreciable extent the building up of the field when re-starting. By means of protective arrangements the winder is automatically shut down in the event of any of the following contingencies:—(1) Failure of power supply,

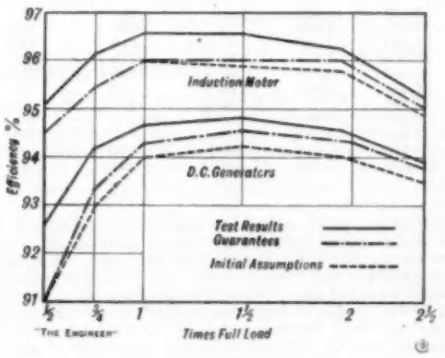


FIG. 8—EFFICIENCY DIAGRAM

(2) failure of exciter pressure, (3) failure of motor field, (4) overload on motor, motor generator or exciter, (5) overspeed of winder motor or motor generator set, (6) overwind, and (7) application of emergency brakes or operation of trip switch.

In the event of any of these conditions arising one or another of a number of protective relays and switches opens a safety contactor in the field circuit of the exciter, thus depriving the generators and the winding motor of their excitation. By means of auxiliary contacts on the safety contactor the emergency brake solenoid is at the same time de-energised, so that the brakes are immediately applied. As regards contingencies (1) to (4), the protective relays in the respective circuits are of the usual no-load and overload type. The winding motor is guarded against overspeed by being directly connected electrically to the generators, so that in the event of it attaining a greater speed than that corresponding to the generator voltage a regenerative braking effect loads the motor electrically. If the regenerative voltage becomes excessive the overload trip operates and shuts down the equipment. The converter set is protected against overspeed by an adjustable centrifugal overspeed device fitted at one end of the shaft and by an over-voltage relay operated by a magneto driven from the motor generator shaft. The magneto also operates an electrical speed indicator which is mounted on the driver's instrument pillar. An indication of the speed of the motor generator set is also given on the set itself by a dial type tachometer with a red mark to indicate normal speed.

Protection against overwind is given by trip switches fitted on the headgear and actuated by the cages and by special switches operated from the depth indicator. In connection with the headgear limit switches a pedal-operated backing-out switch is provided to enable the safety circuit to be completed so that the cage can be backed out, and an additional directional switch is provided to ensure that the winder is re-started in the correct direction. The overwind switches operated from the depth indicators are of a simple and interesting type, developed and patented by the Metropolitan-Vickers Company. The switch is tripped by the friction of a wire rope over a pulley on the switch handle shaft, one end of the wire being attached to the depth indicator and the other end to a suspended weight. After tripping, the switch is reset by hand, but it is reopened by the drive on the pulley if the slightest further movement is made in the wrong direction. The emergency trip switch, which is of the same type as that described, is mounted in a convenient position on the driver's platform, the wire being attached to the emergency brake mechanism so that the wire moving over the pulley trips the switch immediately the brakes are applied. Alternatively, the switch may be tripped by hand. In either case the opening of the switch, like the operation of the other protective switch relays, opens the holding circuit of the safety contactor, thereby cutting off the excitation from the machines and applying the emergency brakes if the electrical shut down is not itself the result of the emergency brakes having been applied.

Two other devices contribute to the safety of the equipment, *i.e.*, a discriminative braking device and automatic acceleration and retardation gear.

The discriminating braking device ensures that if the cage is within the limits of safety in the intermediate part of the travel the application of the brakes is made slowly. Unnecessary shocks owing to sudden braking are thus avoided. When a cage reaches a predetermined distance from the bank a limit switch acting in conjunction with a solenoid causes a by-pass to be opened at the slow braking dashpot, so that prompt and rapid application of the brakes may be made if required. The rates of acceleration and deceleration of the winder are automatically limited to values which are found to give the best results in service, and to this extent the control of the winder is effected independently of the driver. The varying limits are imposed by cams fitted to the depth indicator. At starting, the acceleration cam prevents the control lever being moved further than is sufficient to give a creeping speed, but as the cam rotates owing to the movement of the depth indicator it allows the controller gradually to be moved to the full-speed position. But the lever may be moved as slowly as the driver wishes or may be held stationary in one position. When the point is reached at which retardation should commence the retardation cam forces the controller gradually back to the creeping speed position, the driver merely making the small final movement to the off position. Even if he should fail to do this, the cage could only proceed at the creeping speed until the overwind limit switch was tripped.

The contracts for the equipment were placed on behalf of City Deep, Ltd., by the Central Mining and Investments Corporation, Ltd., for which company Mr. W. Elsdon Dew acted as consulting engineer, and Messrs. Preece, Cardew and Rider as inspectors in this country. The main contractor was the Metropolitan-Vickers Electrical Company; the sub-contractors for the mechanical portion were Blanc and Co., Ltd., of Johannesburg; the mechanical equipment being supplied by Fullerton, Hodgart and Barclay, Ltd.

SIXTY YEARS AGO.

A REVIEW of a book, "Our Ironclad Ships," by Mr. E. J. (Sir Edward) Reed, Chief Constructor of the Navy, which appeared in our issue of January 21st, 1870, enables the modern reader to understand something of the peculiar situation which in those days attended the design and construction of naval vessels. It is, perhaps, desirable that the modern reader should understand that situation. Before the year was out a great disaster was to occur to the British Navy, the loss of H.M.S. "Captain" and her crew of several hundreds. In due time we shall deal with that disaster as it appeared to those concerned with naval matters at the time of its occurrence. To-day, we need only remind our readers that on the tablet erected in St. Paul's Cathedral to the memory of those who perished when the vessel capsized it is recorded that she was built in deference to the insistent demands of the public. By inference the public is blamed for the disaster. It seems extraordinary to us to-day that the public should have any voice in specifying the design of a warship and that the Admiralty, against its alleged better judgment, should consent to dictation in this respect. Scarcely less extraordinary does it seem that a Chief Constructor of the Navy, while still holding office, should publish a volume of 320 large octavo pages seeking to defend his policy in the matter of ship construction. The times were, however, peculiar. The period was one of transition. "The spirit of invention," as Mr. Reed wrote in his book, "was setting at naught all past systems of ocean warfare and mocking at every trace and tradition of the times when we won our naval renown." Public criticism had become loosened from its usual restraints and undoubtedly ran into error and extravagance. Scarcely a journal in town or country, Mr. Reed wrote, refrained from prescribing the proper forms, dimensions and fighting features of warships. Inventors, contractors, patentees and many others found the times opportune for the promotion of their interests, and, so said Mr. Reed, it was to the benefit of a large number of people to complain of, and even to denounce, the ships built by the responsible authorities. Mr. Reed had to confess that most of his work as Chief Constructor during the preceding seven years had been done in an atmosphere of other than absolute composure, and that he had been subjected to the fire of noisy and distracting, if not always powerful, ordnance. It is easy to understand Mr. Reed's desire to defend himself against the critics of the ships which he and the Board of Admiralty had given the Navy. It is less easy to understand why these critics were allowed to influence the Admiralty experts' judgment to the extent implied in the placing of the order for the "Captain." Modern opinion must, we think, lay the blame for the disaster which followed as much at the door of the experts who yielded to the popular clamour as at that of those who raised it.

Water-tube Boilers for Merchant Ships.

IN a paper read before the Institute of Marine Engineers on Tuesday evening, January 14th, Engineer Rear-Admiral W. M. Whayman reviewed the position with regard to water-tube boilers fitted into merchant ships from the year 1924 to the present date. In opening his paper Admiral Whayman recalled the earlier paper of the late Sir James Kemnal of 1924 and that of Mr. Stanley S. Cook in 1926, and showed that the results from high-pressure and high-temperature steam installations had entirely fulfilled the anticipations of the authors. From a list of steamships which were completed or were now in course of construction and were fitted with one type of water-tube boiler it was shown that whereas in 1925 the usual pressure was 200 lb., in the case of ships ordered in 1927 the pressures were advanced in some cases to 250 lb., 290 lb., and even 430 lb., and in other cases of ships ordered in 1928 to 370 lb. and 550 lb. pressure. The amount of superheat in use in 1925 was about 180 deg. Fah., which has remained somewhat of an average figure, though there were cases in which a higher temperature of 260 deg. Fah. were used. The author then made reference to the excellent results obtained by Mr. J. Johnson in the "Duchess" class of C.P.R. liners, published figures for the "Duchess of Bedford" showing a consumption of 0·57 lb. of oil per S.H.P. hour for propulsion and 0·625 lb. for all purposes. With regard to electrically propelled liners, Mr. Eskel Berg's recent paper before the Institute of Marine Engineers was recalled. In it a figure of 0·715 lb. of oil per S.H.P. hour for all purposes was given for the s.s. "Virginia." Mr. Berg also credited the North German Lloyd liner "Bremen" with a figure of 0·685 lb. for all purposes, and suggested that with an electrically-propelled ship larger than the "Virginia" the existing 0·715 figure could be improved upon. Some particulars were then given of the installation of Babcock and Wilcox 430 lb. pressure boilers in the Holland-America liner "Statendam." An average maximum efficiency of 84 per cent. upon a gross calorific value of fuel oil of 18,500 B.Th.U. per pound was referred to as being obtained in service, with efficiencies also under service conditions of 87 to 88 per cent.

In order to illustrate the progress made in water-tube boiler design within the last five years the author proceeded to describe representative installations which have been fitted in cargo and passenger vessels in the period between 1926 and 1929. Particulars of these ships and their boiler installations are given in the accompanying Tables Nos. I. and II., and in the paper drawings of the boilers were reproduced. Reference was also made to the six Babcock and Wilcox boilers which are now being installed in the new Belgian State Railway steamers for the Dover-Ostend service. Some detailed particulars were given of the two boilers recently installed in the high-pressure Clyde steamer "King George V." Reference was made to this installation in the last issue of THE ENGINEER.

Speaking on the service obtained from these boilers, Admiral Whayman said that examination of the boilers at the end of the season's service showed them to be in very good condition and with only such wear and slight distortion of some baffles, tube supports and a few casing plates as might have been expected. The state of the furnace at the end of the season was in every respect good, the fire-bars being practically in their original condition. The brickwork was good and the cast iron grids were also in good condition, except that the grids in the back wall began to show signs of erosion at the top of the air supply inlets. Slight alterations have been made still further to improve the durability of those parts showing signs of wear and distortion ready for the next season's service. The steaming of the boilers on service was easy and normal, and it is claimed that the boilers have established their reliability and good durability at the designed pressure and temperature of 550 lb. and over 700 deg. Fah. The further service in this Clyde passenger steamer will be awaited with interest. A final illustration of boiler installations showed the boiler which is being built for installation in the United Fruit Company's steamer "La Marea." The working pressure of this boiler is 400 lb. and final temperature at the superheater outlet of 710 deg. Fah.

In Table II. the figures for the weight of the boiler and the space taken up in the various installations described are collected and compared. The author said that in many cases he had gained the impression that the boiler installations were too cramped and that space for proper supervision had not been provided. If the results obtained on trial were to be continuously repeated in service, then it was essential, he thought, that reasonable accessibility to all boiler parts should be given.

In the three curves reproduced in Fig. 1 the rise in boiler pressure, the increase in evaporation per square foot of boiler floor space and the increase in evaporation per ton of boiler weight with the increase in pressure are shown for the various ships considered in the paper. Comparing the boilers of the "Statendam" and "Viceroy of India," which have the same specified evaporation per square foot of boiler heating surface, Admiral Whayman pointed out that, although the horizontal and larger tube boiler was heavier than the vertical and small-tube boiler, it was not greatly so, and it appeared to have some advantage in the matter of floor space. Some interesting particulars with regard to a new type of light-weight boiler, built and tried in America by the Babcock and Wilcox Company, and described by Mr. J. H. King in a paper on "Increased Economy in Marine Steam Machinery, with Special Reference to Marine Boilers," which was read before the Society of Naval Architects and Marine Engineers in New York in November, 1929, are given in Admiral Whayman's paper. A section through a boiler of this particular type is reproduced in Fig. 2. Its construction, Mr. King states, provides no untried mechanical elements. In its use of sectional headers, nipples, &c., it follows the design of the usual Babcock and Wilcox marine boiler, which has been thoroughly proved in many years' service. The headers, however, are cylindrical, thus permitting of grouping a large number of tubes that are accessible for expanding, inspection and cleaning from a single handhole plate. In the design in the particular boiler shown in Fig. 2 sixty-six tubes are made accessible by the removal of one handhole plate. The arrangement of the cylindrical headers, with a decreasing area of gas passage through the boiler, results in a uniformly high rate of heat transfer. A superheater, which is of the inter-deck type, is arranged above the lower bank of generating tubes. These tubes are referred to as a water screen, as they screen the superheater from the radiant heat from the furnace. The first two, or fire, rows of tubes are 1¼in. in diameter and the next three rows are 1¼in. in diameter. All the tubes above the superheater bank are 1in. in diameter. The drum is of riveted construction, 42in. in diameter and built for a working pressure of 600 lb. A boiler of this design and size of drum can be built for 750 lb. working pressure without any change, except a slight increase in the thickness of the drum shell. At very high pressures an air heater or economiser can be added if desired. The boiler has been constructed and tried on shore and efficiencies of over 80 per cent. have been obtained with the boiler and superheater only without an air heater. The trials are being continued.

Dealing with drum construction, the author pointed out that although the seamless drum with closed ends had been introduced for high steam pressures, he considered it quite a practical proposition to use a riveted drum up to 650 lb. pressure. With modern methods of riveted construction, he said, the possibility of trouble with the riveted seams by the commencement of steam leakage through the seams from inside was very remote, and there should be no hesitation in using the riveted method of drum construction if desired.

In the concluding parts of the paper questions of superheating and de-superheating and the treatment of boiler feed with tri-sodium phosphate were dealt with and recommendations made. The supply of air for the combustion of fuel was also discussed, and the author stated that he felt that the closed stokehold system with heated air supplied by ducts from the air heaters to the furnaces would be increasingly used. He regarded the experience gained with installations working at higher temperatures and pressures as satisfactory, in that reliability and low cost of maintenance were being proved, and, as further experience was gained, further improvements in plant would undoubtedly take place. The outlook for either mechanical stokers or pulverised fuel with marine water-tube boilers was, he regarded, promising.

TABLE I.—*Typical Performances of Marine Water-tube Boilers.*

Name of ship	"Duke of Lancaster."	"Beaverbrae."	"Op Ten Noort."	"Nieuw Holland."		"Statendam."
Steaming conditions	5 hours' trial.	8 hours' trial.	Service.	6 hours' Trial.	Service.	Contractor's trial.
Boiler or superheater outlet pressure, lb./sq. inch	291	212	206	279	260	405
Saturated steam temperature, deg. Fah.	388	392	390	414	410	449
Boiler or superheater steam temperature, deg. Fah.	388	661	500	580	594	675
Degrees of superheat	—	269	110	166	184	226
Feed temperature, deg. Fah.	194	172	158	171	241	270
Number of boilers	5	4	4	3	4	6
Total evaporation, lb.	87,420	59,600	74,974	68,530	67,980	192,500
Evaporation per boiler, lb.	17,484	14,900	18,743	22,843	16,995	32,083
Type of fuel	Coal	Coal	Oil	Oil	Oil	Oil
Fuel value, gross B.Th.U.	13,100	13,730	18,600	19,000	18,500	18,500
Fuel per boiler per hour, lb.	1,873	1,756	1,438	1,702	1,263	2,292
Steam per lb. of fuel, lb.	9·3	8·5	13·03	13·7	13·4	14
Steam per sq. foot boiler heating surface, lb.	5·3	4·35	5·54	6·67	4·86	4·48
Overall boiler efficiency on gross fuel value, per cent.	75·6	75	80	82·5	84·2	84·5
Description of installation	Boiler	Boiler, inter-deck superheater and airheater	Boiler and superposed superheater	Boiler, superposed superheater and airheater		Boiler, inter deck superheater and airheater
Heating surfaces in square feet: Boiler	3,295	3,170	3,387	3,483		7,160
Heating surfaces in square feet: Superheaters	—	690	925	1,600		1,680
Heating surfaces in square feet: Airheaters	—	3,600	—	3,830		7,160
Gas temperature out of Boiler, deg. Fah.	—	484	—	605	550	535
" " " Airheater, deg. Fah.	—	335	—	423	406	360
Description of fuel	Coal	Coal	Oil	Oil	Oil	Oil

TABLE II.—*Weight and Space of Marine Water-tube Boiler Installations.*

No.	Name of ship.	Steam generating plant.	Evaporation, lb. per hour.	Boiler H.S. sq. feet.	Boiler-room floor area, sq. feet.	Evaporation / Floor area	Total weight with water, tons.	Evaporation / Weight
1.	"Duke of Lancaster"	Boiler	120,000	19,770	2,126	56·5	253	475
2.	"Canterbury"	Boiler	118,500	17,072	1,680	70	220	538
3.	"Prince Leopold"	Boiler and superheater	152,460	21,300	2,202	69·3	318	480
4.	"Op Ten Noort"	Boiler and superheater	72,000	17,536	2,079	34·6	375	192
5.	"Scottish Chief"	Boiler and superheater	55,000	11,588	1,424	38·5	243	226
6.	"Beaverhill"	Boiler, superheater, and airheater	64,000	12,680	1,665	38·4	264	252
7.	"Nieuw Holland"	Boiler, superheater, and airheater	88,000	13,932	2,120	41·5	336	262
8.	"La Marea"	Boiler, superheater, and airheater	45,000	8,660	840	53·5	173	260
9.	"Statendam"	Boiler, superheater, and airheater	210,000	42,960	4,278	49	744	282
10.	"King George V."	Boiler, superheater, and airheater	36,000	4,560	612	60	90	400
11.	"Viceroy of India"	Boiler, superheater, and airheater	160,000	32,500	3,950	40·5	505	316

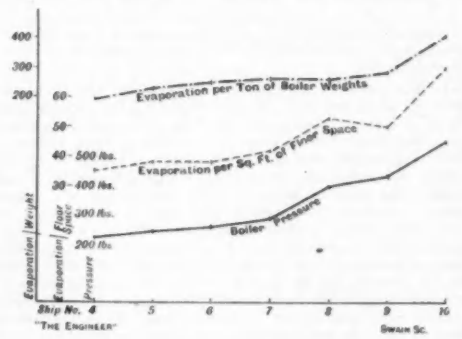


FIG. 1

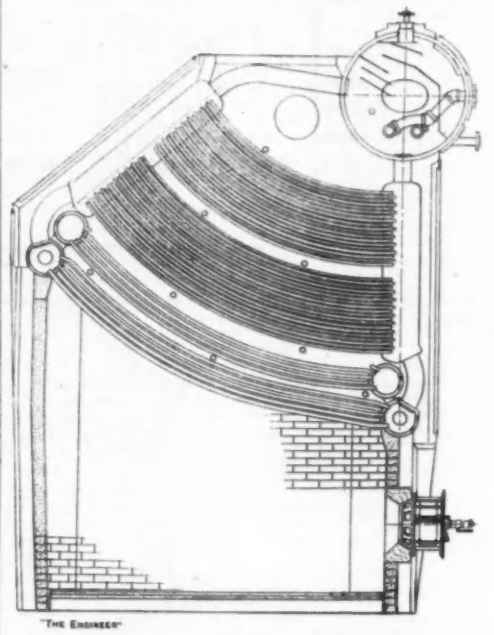


FIG. 2—SECTIONAL WATER-TUBE BOILER

THE HISTORY OF BOILER INSPECTION.

A LECTURE on "The History of Boiler Inspection" was given by Mr. William Ingham, M.I. Mech. E., at a recent meeting of the Oldham and District Engineers' Association. Mr. Ingham was formerly assistant chief engineer to the National Boiler and General Insurance Company, which was founded by Sir William—then Mr.—Fairbairn in 1854. Mr. Ingham joined the Association in 1872 and took part in the repeated testing to destruction of a full-sized Lancashire boiler, which ultimately failed at the longitudinal seams at within 5 lb. of the calculated pressure. Another experiment with which Mr. Ingham was connected was that of injecting cold water on red-hot furnace crowns in order to disprove the widely held fallacy that explosions were caused by running cold water into red-hot boilers. the Manchester Steam Users' Association was the pioneer of all boiler insurance companies. Prior to the introduction of the Boiler Explosions Acts of 1882 and 1891 Mr. Ingham claims to have investigated most of the boiler explosions which occurred in the North of England and Midlands, and he mentioned cases of disastrous explosions from which much useful information was obtained and which contributed largely to the building up of the present system of boiler inspection and insurance. Turning to present practice, Mr. Ingham said that the steam engine had probably reached its limits of economy, but that there was still much to be done towards improving boiler efficiencies, which were at present only about 60 per cent. of the calorific value of the fuel, against a possible efficiency of about 80 per cent.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

General Conditions.

THE iron and steel and engineering industries of the Midlands and Staffordshire are moderately engaged, and the demand for material is fair. There has been no great change in the situation during the past week, the quarterly meeting having failed to revive the buying instincts of consumers of iron and steel. The position at the moment and the immediate outlook are considered problematic, and fraught with uncertainties which militate against freedom of action. Caution predominated in all branches of the market and business is of a hand-to-mouth character. Values are substantially unchanged, though the tendency in the raw iron department is towards a higher level. Local industries are unevenly engaged, a state of affairs which, judging by the reports of representatives of firms who attended last week's meeting, exists pretty generally the country over. While some branches of engineering, such as automobile, electrical, and rolling stock engineers and machine tool makers have good order books, and are anticipating a busy year, constructional engineers and general engineering works are quiet, and have a hazy outlook. Business so far this year has been disappointing. It will need to mend enormously if industry in this area is to experience in 1930 a really successful year's trading.

Pig Iron Values.

Although it is only in exceptional instances that prices above the Association minimum basis rates for foundry pig iron are paid, there is undoubtedly a tendency towards a higher range of selling prices. Midland blast-furnacemen maintain their strong position, their output being fully booked. Consumption at the foundries hereabouts is substantial, specifications against contracts accounting for the distribution of a heavy tonnage of iron. Furnacemen have as much as they can do to keep customers regularly supplied, and merchants report difficulty in getting prompt delivery, especially from the Derbyshire furnaces. This condition of things is not present in the forge branch of the industry, however. Output of forge material, both of Derbyshire and Northamptonshire make, is restricted, but even so it exceeds demand. Unfortunately, the outlook at forges in the Black Country is not good, and very little improvement in sales of forge pig this quarter seems probable. Blast-furnacemen who are still paying dearly for coke—about 18s. per ton at ovens—uphold recent selling values. Derbyshire forge is quoted firm at £3 14s. 6d. and Northamptonshire at £3 11s. The coke position remains very uncertain. A spell of winter weather would probably result in increased selling price of coke. This would almost assuredly be passed on to the consumer of pig iron. Interest now centres in the meeting of the Central Pig Iron Producers' Association at the end of this month, when a revision of prices will be considered. At date, Derbyshire No. 3 foundry iron is £3 18s. 6d. and similar material of Northamptonshire make £3 15s., both per ton delivered to Black Country stations.

Staffordshire Bar Iron.

A steady demand exists for Staffordshire marked bars at £12 10s. per ton. Makers have had, and are having, a good run of business, and in this department of the market a confident tone exists. There is a good reserve of orders on makers' books, and new business comes along regularly. A brisk demand has again developed for chain and cable iron and manufacturers are being pressed for quick deliveries. There is no improvement to report in the Crown bar department, and keen competition prevents ironmasters putting prices on a more remunerative level. Quotations range from £10 to £10 10s. The business transacted is small. Common bars, for nut and bolt and fencing making, have a formidable competitor in Belgian No. 3 iron. Indeed, the native quotation of £9 upwards is relatively so high as almost to preclude the possibility of doing business with Black Country manufacturers of bolts and nuts. By far the greater portion of the material made up in district works is of foreign origin. Wrought iron tube strip is rather less active, but mills, even though they have some difficulty in finding full employment for their resources, adhere firmly to the quotation of £11 2s. 6d. per ton for strip.

Small Call for Steel.

A more encouraging outlook is developing in the heavy steel trade, the railways and shipyards promising better support in the near future than they have given the industry of late. Although the rolling stock works in the Birmingham area are absorbing considerable quantities of steel sections and plates, business generally is quiet. Consumers of heavy steel are well bought, and have no immediate need to negotiate new business. Steel works report a slight improvement in specifications against existing contracts. Demand for boiler plates is moderately good. Prices are unchanged. Steel rollers catering for the automobile industry report the receipt of good orders, but they are not, in the aggregate, up to those received this time last year. In the semi-finished department foreign competition is as keen as ever, notwithstanding the steps taken to curtail output and the fixing of prices by the continental cartel. Native prices of both billets and bars continue weak. There is not a great amount of business being done either in home or foreign half-products.

Sheet Values.

The slump in business in galvanised sheets continues and manufacturers are forced to sell at lower and lower rates. With plants standing for want of orders, the quotation for 24 gauge galvanised corrugated sheets has fallen a further half-crown to £12 5s., and even this figure would be shaded, it is stated, for really desirable business. None of the overseas markets appear to be taking any active interest in the market, the falling away of Indian business being most marked. Some of the district mills, which have cultivated special fields, still have a little work in hand, but more generally orders have been worked off and a new buying movement is awaited with impatience. The home demand for standard lines is very poor, the market in this branch remaining listless. Exports of sheets in December, as was anticipated, showed a further substantial decline over the corresponding month last year, and the year as a whole showed a grand total of sheets exported over £53,000 in value below that of 1928.

Scrap.

Buying of scrap is hardly sufficient to test market values. The majority of Birmingham merchants are quoting heavy steel scrap £3 7s. 6d., but here and there a figure 1s. per ton below this is named. Merchants report difficulty in persuading South Wales steel works to accept deliveries. Stocks here are accumulating.

Trade Returns.

Manufacturers of iron and steel in the Midlands note with some satisfaction that despite a fall of £97,358 in the value of iron and steel exported in December last, the total exports for the year show an advance in value of £1,230,621. On the other hand, imports of iron and steel were up in December, and also on the year as a whole. The value of the increase on the year over the quantity imported in 1928 amounts to £522,137. The quantity imported during the year was 2,816,657 tons, compared with 2,897,250 tons, so that though the tonnage imported in 1929 was smaller than in the preceding year, its value was greater.

Edge Tools.

The heavy edge tool industry in this district has now definitely taken a turn for the better. Many of the important overseas markets show signs of renewed activity and February should bring a considerable volume of business to district works. Trade with the East has taken on a brighter tone, and the position in the South American markets is now less difficult.

Castle Bromwich Fair.

Many Midland and Staffordshire manufacturers are busy just now making and finishing the samples which will adorn their stands at the British Industries Fair at Castle Bromwich next month. Arrangements are now almost complete, and exhibitors regard the prospects of good business resulting from the Exhibition as bright. In the past, the Fair has been productive of valuable orders, both on overseas and home account, and, partly as a result of greater publicity, a larger attendance of buyers than ever before is anticipated. Midland manufacturers are determined to show that they have " the goods " to sell.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Railway Electrification.

THE past week has witnessed a spate of rumours relating to the plans of the railway companies for the electrification of Lancashire lines. The schemes are said to include the electrification of the main lines from Manchester to Liverpool and Southport on the London, Midland and Scottish system, the L.M.S. lines from Victoria Station, Manchester, to Pendleton and Bolton, and also to Miles Platting, Hollinwood, and Oldham, and from London-road Station to Longsight and Crewe; and the electrification of the London and North-Eastern line from Central Station, Manchester, to Hyde-road, Gorton, and beyond. It is understood that a conference is being arranged between railway representatives and the members of the Manchester Underground Railway Committee, the plans of which for a city " tube " have been amended so as to have termini at the five principal railway stations in the centre of Manchester, in order to link up with the proposed electrified lines. A statement made by Sir Josiah Stamp, however, is to the effect that there is no immediate prospect of the electrification scheme outlined above being put into operation, though he adds that electrification on an important scale is a distinct possibility of the next few years. It is further understood that the L.M.S. Company is considering a scheme for the electrification of the Styal branch line from Manchester (London-road Station) to Wilmslow and Alderley.

Additions to Motor Omnibus Fleets.

Manchester Corporation Transport Committee has decided to purchase, at an estimated cost of £49,000, thirty new motor omnibuses to add to the city's fleet. These, with the sixty double-decker vehicles ordered some months ago to replace the tramcars on what is known as Route 53, will bring the total number under the control of the Transport Committee to 211. Salford City Council, on the recommendation of the Tramways and Motor Omnibus Committee at its meeting last week authorised the borrowing of £28,630 for the purchase of eighteen additional motor omnibuses, the tenders of three firms being accepted.

Not to be Closed Down.

Reports that, in addition to closing down the plant at the Yorkshire Steel and Ironworks, at Penistone, the directors of the English Steel Corporation had decided to cease operation at the Openshaw Works, Manchester, have been denied, an official at Openshaw stating that there was little likelihood of the works there being closed down.

Coke Plant's Fate.

Owing to the approaching exhaustion of a particular seam which is relied upon to furnish the slack used in the coking plant, Manchester Collieries, Ltd., will, it is understood, shortly discontinue operations at the Brackley Coke Works, near Walkden. It may be recalled that since it was formed some time ago to take over the businesses of a number of the leading coal-mining companies in Lancashire, several pits under the control of Manchester Collieries, Ltd., have, for various reasons, been closed.

Non-ferrous Metals.

More activity has been in evidence during the past week in one or two sections of the non-ferrous metals market, though much of the improvement has been due, of course, to the return to more normal conditions after the holidays. The demand in the case of copper has been brisker, both in respect of the standard metal and of refined descriptions, and the resultant tendency of prices has been firm. On balance for the week, standard cash is dearer to the extent of about 7s. 6d. per ton, with a corresponding decline in forward positions. For the fourth week in succession, however, ground has been lost in the tin section, this varying on the week from about £1 10s. to £2 per ton, bringing current values back to where they were early in November. Buying of this metal continues on cautious lines, and a further substantial addition to port warehouse stocks of tin in this country, combined with offers on a rather free scale, has exercised a " bearish " influence on the market. With regard to lead, the demand has been fairly active at times, and although there has been no improvement in price levels compared with a week ago, the market has been reasonably steady on the whole. Whilst the movement of spelter during the week has been on moderate lines, the demand has not been sufficient relative to available supplies to stem the decline, and the very slight recovery registered last week has been more than wiped out.

Iron and Steel.

Generally speaking, dull and by no means active conditions are ruling in the iron and steel markets here just now. So far as foundry iron is concerned, both demand and current deliveries in this section keep up surprisingly well considering, and makers are well able to maintain quotations. Staffordshire and Derbyshire makes sell at 77s. per ton for delivery in the Manchester price zone, and Scottish at 95s. per ton and West Coast hematite at about 92s., both delivered equal to Manchester. There has been no material improvement in the case of manufactured iron, the demand for which continues on the very moderate scale ruling before the turn of the year. Prices, however, are steady at £10 15s. per ton for Lancashire Crown bars, and £9 15s. for seconds. In the steel market, the seasonal quietness of the past three or four weeks is perhaps less pronounced, but in the aggregate deliveries of constructional steel materials are no heavier than they were in December. General plates are quiet, although a fair movement of locomotive plates to Lancashire works has been reported this week. Bars, with the possible exception of bright-drawing qualities, are in slow request. The tone of the market is firm all round, however, large steel bars being quoted at £9 7s. 6d. per ton, small sizes at about £9, ship plates at £8 17s. 6d., boiler plates at about £10 for acid and basic sorts, sections at £8 7s. 6d., joists at £8 10s., and small re-rolled bars at from £8 5s. per ton in 10-ton lots to £8 7s. 6d. in smaller quantities. Sellers of imported iron and steel products report a very moderate demand, and few of them are hopeful of early expansion. There has been no notable alteration in quotations in this section, prices for the most part being nominal.

BARROW-IN-FURNESS.

Hematite.

The general tone of the hematite pig iron market is about the same as it was last week, and makers are fairly well fixed as regards orders. Customers, at least some of them, are covering themselves for four to five months ahead. In some cases others are hesitating, owing to higher prices, hoping for cheaper iron shortly. In view of the slightly better outlook in the steel trade, the demand for iron by the steel departments will be better than during the past three months. The continental business has been maintained, and trade with America continues. There was a dispatch of pig iron to Philadelphia last week from Barrow. The iron ore trade is about the same, and there is little chance of any change for some time to come either one way or another. The position in the steel trade is slightly better, and both as regards Barrow and Workington the outlook is fair for the next three months in relation to railway material. There have been several dispatches of rails from Barrow to Algoa Bay, and also a cargo of rails per ss. " Kemnill " to South America. The latter has had to take rails from Workington, *viâ* Barrow, owing to its draught.

Shipbuilding.

Better news is hoped for shortly with regard to shipbuilding, but at the moment there is no official intimation. It is known that orders are about to be placed, and it is hoped that Barrow will share in them.

SHEFFIELD.

(From our own Correspondent.)

Disappointing Conditions.

THE opening of the New Year finds the general steel trade of Sheffield in an unsatisfactory state. A falling off was noticed at the beginning of December, and from this there has not yet been a recovery, with the result that in the heavy departments, and in regard to rolled steel of ordinary descriptions, inquiries are few and unimportant, and much of the business is of a hand-to-mouth character. There are exceptions to this state of things, and cases are to be found of firms which shortened their holiday stoppage owing to pressure of work, but these are few. The output of open-hearth steel is below that of

a year ago, the decline relating principally to acid steel. There is a substantial demand for soft basic material, and at the Templeborough works of Steel, Peech and Tozer nine furnaces out of fourteen are working. At the Rotherham end of the works, however, only two furnaces are in operation. At several other works, the number of open-hearth furnaces operating is smaller than before the holiday stoppage. There is much short time at the rolling mills and forges which work for hire, and but a meagre demand for sheets.

Special Departments Active.

Although one has to speak thus gloomily of the general steel trade, which does not promise to make a good showing during the first month of the year, there is a better story to tell with regard to various special branches. These had good employment during the past year, and their activity seems likely to continue. Specialised qualities of high-grade steels, which have been developed to meet the needs of modern engineering practice, are in increasing demand. The material is costly, and the trade of considerable importance, but it does not represent any great tonnage, and comparatively few firms are engaged in it. There is also a progressive demand for the great variety of steels coming under the headings of stainless, heat-resisting, and corrosion-resisting, as well as for cold rolled steel and strip, the applications of which are continually growing. It has recently been predicted that before long chromium plating of the bright parts of motor cars will be superseded by stainless steel. The cost of the latter, for use in mass-produced motor cars, is at present high as compared with plating, but it is suggested that if the demand grows the price will adjust itself. There is a free sale for alloy steels, but the trade has to meet keen competition from outside centres of the industry as well as from the Continent.

Another Effect of Rationalisation.

Whatever effect rationalisation may have, now or in the future, in reducing costs of production and bringing about increased trade, its present results, from an employment point of view, are proving decidedly unpleasant. Another instance of this is announced by the English Steel Corporation. Among the works acquired by that combine were the Yorkshire Steel and Ironworks, of the Cammell Laird branch at Penistone. Some months ago the tire mill at that establishment was closed, and operations transferred to the works of Taylor Brothers, Manchester, another firm controlled by the Corporation. Now the directors announce their intention of closing the whole of the Penistone works permanently, "as they see no hope of the plant working on a remunerative basis. This decision," they add, "has been taken in conformity with the policy of rationalisation which is being carried out, and is in line with the recommendations made by Mr. Thomas and members of the Government." The staffs, heads of departments, and workmen, have been given notice, to expire on February 1st, and, although the firm says that it may be able to find employment after that date, the engagements will then be subject to termination without notice. The number of people at present employed at the works is about 650, and the figure not long ago was up to 900. The works were established as far back as 1862, and in their time enjoyed great activity in the production of Bessemer and open-hearth steel, rails, tires, &c. There are now six large open-hearth furnaces at the works, all of which have been standing idle for some weeks. The closing of the works will be a serious blow for Penistone, as the population has depended on them for a great part of its employment, and the local authority for a large share of its rates.

Railway Material.

The decline in the call for acid steel is accounted for to a considerable extent by the slackness in the departments producing railway axles, tires, and springs. Specifications for these materials from the British railway companies have been expanding for some time, but their requirements remain a long way below the normal standard. Overseas business is very quiet, little having come to hand since the large orders from South Africa were received in the autumn. There has been no resumption yet of the building of wagons for private owners. The announcement that the London, Midland and Scottish Railway Company is to build 12,000 wagons this year, at a cost of £1,500,000, is of much interest to Sheffield firms. The vehicles will include open and low-sided wagons, standard mineral wagons, covered vans for general merchandise, banana, meat refrigerator and brake vans, cattle wagons, and 20-ton steel hopper wagons.

Large Electrical Contracts.

Comprehensive plans have been drawn up for the main transmission and secondary lines which are to be erected in connection with the Mid-East England electricity scheme. The first of the main lines is to be between Lincoln and Grimsby, and it is expected that the steel masts will be making their appearance on the route within the next two months. A contract amounting to no less than £494,000, has been let to the General Electric Company for overhead lines, and another large one, for £339,000, has been placed with the British Thomson-Houston Company for switchgear. There are still to be let the contracts for the secondary lines and transformers. Over 50 miles of wayleaves have already been secured out of a total of 450.

Cutlery and Plate.

The exceptional activity which characterised the Christmas season in the cutlery and plate trades has been followed by a quiet spell, and comparatively few orders are coming to hand at present. It is not possible thus early in the year, to forecast the future with any confidence, but makers fear that, apart from special contracts for hotel, restaurant, and ship equipment, a period of slow trade is coming. Although the output of cutlery in December was very large, the activity does not appear to have been general, as some makers declare that their turnover was rather less than usual. The outlook for silver and plated hollow-ware is not good. This section enjoyed a spurt last year, when the orders from shopkeepers showed an advance on anything that had been known for a considerable time, but the briskness was not of long duration, and did not reach into the Christmas season. There is a continued decline in the price of silver, but common celluloid is firmer, and an increase is expected shortly.

An Appointment.

Mr. A. Parker Hague, Assoc. Met. (Sheffield), who has been appointed general manager of the Mond nickel works at Swansea, and will take up his duties on February 1st, has been associated with Cammell Laird and Co., Ltd., Sheffield, for twenty-five years, and for the past fifteen years has been manager of the armour-plate department. In addition, he has been chief metallurgist for ten years. He is a member of Council of the Sheffield Society of Engineers and Metallurgists, and serves on several technical committees of the Iron and Steel Institute. He is the author of numerous papers presented to the technical societies. His father was also associated with Cammell Laird and Co. for many years. On taking up his new appointment, Mr. Hague will pay a two months' business visit to Canada.

Sewerage and Water Schemes.

Nottingham Corporation has embarked upon a great scheme for the modernisation and extension of the greater part of the city's sewerage system. The work has now been begun, and in the next few months hundreds of local unemployed will be engaged upon it. It will take about six years to complete the scheme, the total cost of which will be over £1,000,000. Acting on suggestions made by Mr. J. Haworth, general manager and chemist of the Sheffield Corporation sewage works, and the pioneer of the bio-aeration system, Chesterfield Town Council is to carry out extensions and alterations at its Whittington sewage works. The bio-aeration plant is to be increased by the addition of a fourth unit, and the area of the sludge lagoons is to be enlarged. The cost is estimated at £20,000. Bridlington Rural Council, in response to an appeal from the Ministry of Health regarding rural water schemes for providing work for the unemployed, has decided to ask for a grant for the carrying out of the Hunmanby water supply scheme, and for speedy consent to the construction of a reservoir in connection therewith.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cutting Steel Costs.

It is understood that good progress is now being made with the negotiations between Dorman, Long and Co., Ltd., and the Furness group of iron and steel companies with the object of effecting a geographical rationalisation of the iron and steel industry on Tees-side, and establishing a working agreement between the two groups which will enable production costs to be reduced. Recently the works of the two groups have been inspected by the directors and technical advisers of the concerns as a preliminary to the establishment of a basis upon which a working agreement could be founded. Up to the present no scheme has been evolved, but there is a recognition of the advantages to be derived from such a step, and it is probable that an agreement on the lines indicated will be reached in the near future. The Furness group comprises the South Durham Iron and Steel Company, Ltd., with works at Stockton and West Hartlepool; the Cargo Fleet Iron Company, Ltd., and Cochrane and Co., Ltd., Middlesbrough. An arrangement with this group and Dorman, Long and Co., Ltd., would secure the operation under unified control of the whole of the iron and steel industry of Tees-side with obvious advantages, which have already been secured to a smaller degree as the result of the amalgamation of Dorman, Long and Co. and Bolckow, Vaughan and Co.

Cleveland Iron Trade.

Some little improvement in inquiry is noticeable in the Cleveland pig iron trade, but business develops slowly. Although under the latest ascertainments the blast-furnacemen and ironstone miners have received advances of 2¾ and 3 per cent. respectively, the slight addition to the cost of production is offset by an easier market for fuel and ore, and no upward movement in pig iron prices is anticipated. Buyers, however, count on stabilised prices and are not in a hurry to commit themselves far ahead. Much may depend on the action of the Midlands ironmasters who are said to be contemplating an advance. Meanwhile, the outlook is hopeful. Foreign sales are few, but the great bulk of the iron produced in this district is going into the steel furnaces, and there is an assured outlet in this direction for some time to come. Stocks of iron, moreover, are not heavy, and any increase in the demand would speedily necessitate a bigger output. Cleveland producers are not at all disposed to break the minimum fixed quotations that have ruled for some months past. No. 1 foundry iron is 75s., No. 3 G.M.B. 72s. 6d., No. 4 foundry 71s. 6d., and No. 4 forge 71s.

Hematite Pig Iron.

Contrary to expectation, East Coast hematite quotations have not moved upward since the turn of the year, and conditions in this branch are causing uneasiness. Production cost is declared to be quite 80s. per ton, and merchants who are well bought are unloading their holdings rather freely at 79s. Consumers, indeed, claim that they can shade the figure generally named by second-hands. Makers report contracts arranged around 80s. for delivery up to the end of March. No. 1 hematite is at a premium of 6d. per ton.

Ironmaking Materials.

Foreign ore quotations are difficult to fix. Doubtlessly purchases could be made on lower terms than have been quoted recently. Best Rubio ore is not more than 23s. 6d. per ton c.i.f. Tees. Blast-furnace coke continues plentiful, and makers are pressing sales. Good average qualities are offered at 22s. 9d. per ton delivered at North-East Coast works, and possibly that figure could be shaded.

Manufactured Iron and Steel.

In the manufactured iron and steel trade business generally is fairly brisk, and makers, taking an optimistic view of the outlook, adhere firmly to quotations. Producers have still quite a large amount of work to execute, and are booking further orders. Activity at the shipyards promises to keep manufacturers of material for construction of vessels busy for some time, bridge builders have good order books, and producers of railway material are well sold.

The Coal Trade.

The northern coal market maintains a good tone throughout, the accumulation of old orders being sufficient to clear off all the full maximum output from the pits, and there is every prospect of a continuance of a good tonnage supply. Fitters anticipate being able to keep the pits at full work for some weeks ahead and will have little or no surplus for the open market. Some of the collieries are heavily sold and the loadings are likely to be on a large scale to the end of the month at least. The prompt position retains full strength, but so far the weather conditions have not been sufficiently severe to stimulate forward buying. Reports from continental centres state that the ports are heavily stocked with coal and that the recent mild weather spell has severely curtailed the general demand, and continental buyers, while sounding the market, are holding off from definitely committing themselves. This reacts on local conditions, and buyers on this side fully anticipate being able to secure some bargains by holding off for a short period. Northumberland steam coal is scarce for the next week or two, and it seems that the position has lost none of its former strength. Buyers, however, are not pressing, and their ideas of price are up to 3d. below the minimum quoted prices. Best steams are held for 17s. to 17s. 3d. Other Northumberland steams are maintained firmly at 16s. to 16s. 6d. Steam small coal is in brisk demand and scarce for this month's shipment. Best qualities are fully 11s. 6d. and good second grades 11s. to 11s. 3d. Steadiness is evident in the Durham market, although there is a tendency to quietness further forward. Late prices are firmly held, however. Durham best steams are at 18s. 6d. for best sorts and 14s. 6d. for smalls. Gas coals show no change at 17s. 3d. for specials, 16s. 9d. for bests, and 15s. 6d. to 15s. 9d. for the lesser descriptions. Coking coal is scarce at from 15s. 6d. to 16s., according to class. There is only a sparing supply of bunkers, which continue firm. Best and superiors are at 16s. 3d. to 17s., and ordinary makes at 15s. 3d. to 15s. 6d. The demand for coke has fallen away and there are now stocks to clear. Ordinary patent foundry coke appears weak and tends lower at 20s. to 21s. Gas coke is in moderate offer and quieter at 25s. 6d. to 26s.

Cleveland Miners' Wages.

An agreement has been reached between the Cleveland ironstone mine owners and the miners' representatives whereby the wages of the men will be advanced by 3 per cent. from the 27th inst. This alteration raises the percentage payable on standard rates from 58 to 61 per cent.

SCOTLAND.

(From our own Correspondent.)

Quiet Restart.

The steel, iron and coal markets have not resumed their pre-holiday activities. The majority of the steel and iron works only restarted last Monday, and though the collieries began operations earlier, full working conditions have not yet been established. Extensive repairs have enforced a prolonged stoppage at some establishments, but the general resumption will probably be accomplished before the end of this week.

Steel and Iron.

Markets have been more or less of a holiday nature. Inquiries on the whole have been light, and indicate only a very moderate activity in most departments. Steel plates and sections have not received much attention, and are likely to be somewhat short of specifications. Ordinary sheets are comparatively well placed, but galvanised descriptions have very modest demands. Steel tubes have a fair general demand. Bar iron remains a featureless branch, and gives no indication of improvement. Re-rolled steel bars, meantime, also show continued weakness, specifications being small and mostly for miscellaneous lots, with prices still on the basis of £7 12s. 6d. per ton, home or export.

Pig Iron.

The demand for pig iron continues on very quiet lines, and apart from some deliveries against contracts, practically nothing is being done. Outputs are further curtailed as the five furnaces which were damped down before the New Year holidays cannot be productive for some weeks yet.

Scrap.

Although there is a little more activity in scrap, business is by no means brisk, and prices remain on recent levels, as follows:—Heavy steel, 70s.; heavy basic and cast iron machinery, 69s. 3d. per ton.

Locomotive and Shipbuilding Contracts.

Reports state that the North British Locomotive Company, Ltd., Glasgow, has secured a contract for light

standard gauge "Pacific" type locomotives from the Shanghai–Nanking Railway. The Blythswood Shipbuilding Company, Ltd., Glasgow, has received an order for a motor oil tanker of 11,500 tons deadweight from London owners.

Coal.

Conditions in the coal trade have been quiet since the holidays. Outputs have not been particularly good, and home and export orders on hand have been sufficient to absorb all supplies. Within a few days, however, the production will have assumed pre-holiday proportions. Foreign inquiries are light, but in any case exporters are not disposed to operate extensively, and the tendencies of the market are more defined. Round coals are comparatively well placed in most districts, but especially in Fifeshire, where the collieries are well sold for January, and have a number of old orders still to work off. Washed nuts, however, are in need of fresh business. Aggregate shipments during the past week amounted to 212,363 tons, against 176,078 tons in the preceding week, and 197,737 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

Coal Trade Conditions.

A QUIETER tone all round has developed in the steam coal trade, and new business for prompt loading is slow to make its appearance. Many of the leading colliery and exporting undertakings have substantial commitments, and the position of collieries would not be so bad if the consumers and buyers abroad took out the quantities arranged for. It is not surprising to find that buyers abroad hold off as far as possible, in view of the fact that outward rates of freight continue to be so weak, and there seems to be no bottom to the market, except for South American destinations, for which freights maintain steadiness. Foreign consumers naturally desire to buy on the best terms possible, and with weak rates of freight prevailing they look for continuous reductions in c.i.f. prices. The surprise is that so much tonnage is kept in commission when rates are so unremunerative, but doubtless before very long the increasing number of steamers being laid up will have the effect of steadying rates, and then some recovery can be looked for. At the moment the position of most collieries is fairly good, but by no means as good as was the case a week or so ago. As the result of arrivals over last week-end there were eighteen steamers waiting to load at South Wales ports, while ten tips were idle, from which it will be seen that the abnormal loading pressure of a short time ago has been substantially reduced. While, however, fresh business for prompt loading is undoubtedly quiet, it is interesting to note that the Andalucian Railways of Spain have purchased their requirements of about 32,000 tons of large steam coals for shipment during the first half of this year, and the Central Railways of Brazil have placed an order with one of the leading Cardiff undertakings for 100,000 tons of two-thirds large and one-third smalls for delivery at Rio de Janeiro over the next three months. No official details can be obtained regarding the actual purchases of the Italian Government on account of the Italian State Railways under the Hague agreement by which it undertook to take 1,000,000 tons of coal from this country during the current year and the next two years. Purchases have undoubtedly been made, and shipments are to be begun in February, but it is understood that the purchases effected are less than the total recently mentioned of about 800,000 tons. It is the Italian Government's intention to make further purchases later, as it requires the coals. It is interesting, at any rate, to know that the Italian Government has so far confined its orders to Monmouthshire coals, and has not gone to other districts in this country for its requirements.

Docks Traffic During 1929.

The Great Western Railway Company has now issued details of the traffic at the six ports in this district under its control for last year, and these show that the returns are the best for the last five years. The aggregate of imports and exports was 38,411,909 tons, made up of 5,179,866 tons imports and 33,241,043 tons exports, which compares with an aggregate for 1928 of 34,656,293 tons, made up of 4,949,254 tons imports and 29,707,039 tons exports. The best year previously to 1929 was 1924, when imports and exports came to 40,392,458 tons, made up of 6,000,236 tons imports and 34,392,222 tons exports. Coal and coke exports for 1929 amounted to 29,802,482 tons, which compared with 26,376,143 tons for 1928. Oil imports showed a substantial falling off, as the total for last year was 944,570 tons as against 1,137,568 tons for 1928. Tonnage trading to South Wales ports last year was increased. The number of ships was 22,014, of 17,986,023 net register tons, which compares with 20,434 vessels of 16,472,334 net register tons in the previous year.

Steel Trade Items.

Reference was made last week to the rationalisation of the steel industry of this district, and the association of Guest, Keen and Nettlefolds, Ltd., with Baldwins, Ltd., and mention was made of the fact that there was naturally much speculation as to what the effect of this development would be. Unfortunately, the news is not good for many workers, inasmuch as it is announced that a number of men at the Cardiff Dowlais steel works received at the end of last week seven days' notices, though there is the chance that at the expiration of these notices, day-to-day contracts will operate. It is stated that the men concerned have only been working of late 60 per cent. of the time, owing to the fact that there has not been enough work to go round. So far as the Ebbw Vale works are concerned, there has been no development, except that a deputation representing the workers in the iron and steel section has had an interview with the management respecting the possibility of resuming work, but no official statement is forthcoming as to what occurred. Better news comes from the Newport district, as Mr. L. D. Whitehead, managing director of the Whitehead Iron and Steel Company, Ltd., of Newport and Tredegar, states that his firm is installing a new mill at its Newport works. It will be the largest producing unit of its kind in the world. Contracts have been placed locally for the foundations and buildings and all the equipment will be made in this country. It is expected that the work will occupy about nine months, and when the mill is working at full capacity it will mean the employment of about 300 men.

Fuel Workers Resume.

The stoppage of work on the part of the workmen at the fuel works at Swansea has come to an end. Representatives of the workmen interviewed the employers at Cardiff on Monday and their terms were recommended to the 700 men at Swansea for their acceptance on Tuesday. Although there was some opposition on the part of some of the workers, the voting was practically unanimous in favour of the terms, which were that the men should return to work in the same position as they were on December 31st last. Negotiations are to continue until March 19th, and if they fail then the matter is to go to arbitration. The employers' demands are for a reduction in wages and longer working hours.

Swansea North Dock.

The Great Western Railway Company has given notice of its intention to close down the North Dock, Swansea, on February 17th. The company obtained powers in 1928 to close this dock, which is to be filled in, and the available space utilised for the construction of street improvements at Swansea.

Current Business.

The inquiry for prompt supplies is less pressing, and the position of collieries is becoming more irregular. In the case of many qualities of large coals, prices are being quoted at the minimum. Sized descriptions are not so firm, but still maintain a relatively good tone, while smalls are by no means plentiful and are steady. Coke demands have eased off, but the demand for patent fuel is well upheld. Pitwood is weaker at about 27s. 6d. to 27s. 9d.

LAUNCHES AND TRIAL TRIPS.

MARNIX VAN ST. ALDEGONDE, twin-screw motor mail ship; built by Netherland Shipbuilding Company, to the order of the Stoomvaart Maatschappij "Nederland;" dimensions, 608ft. 3in. by 74ft. 6in. by 47ft. 3in.; to carry passengers and mails. Engines, Schelde-Sulzer Diesel motor of 7000 B.H.P.; launch, December 21st.

DUDLEY ROSE, steel screw steamer; built by D. and W. Henderson and Co., Ltd., to the order of Richard Hughes and Co., Liverpool; dimensions, 250ft. by 37ft. by 18ft. 6in.; to carry cargo. Engines, triple-expansion, 19in., 31in. and 52in. by 36in. stroke, pressure 180 lb. per square inch; constructed by the builders; trial trip, December 23rd.

MARATHON, steamship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of Messrs. Hallo and Peterson, of Oslo; dimensions, 440½ft. by 58½ft. by 33½ft.; to carry 10,725 tons. Engines, triple-expansion, pressure 180 lb. per square inch; constructed by the builders; launch, December 30th.

TALUNE, single-screw steamer; built by Blythswood Shipbuilding Company, Ltd., to the order of Union Steamship Company of New Zealand, Ltd.; dimensions, 330ft. by 45ft. by 22ft. 3in.; to carry cargo. Engines, triple inverted direct-acting surface condensing engines, 23½in., 40½in., 66in. by 45in. stroke; constructed by D. and W. Henderson and Co., Ltd.; launch, December 30th.

CONTRACTS.

JOHN DAVIS AND SON (DERBY), Ltd., of All Saints' Works, Derby, have received an order for miners' electric hand lamps and equipment for the Florence Coal and Iron Company, Ltd., Longton, Staffs.

RICHARD GARRETT AND SONS, Ltd., of Leiston, have recently received orders for a total of nine standard rigid six-wheeled wagons from six separate customers; for two rigid six-wheeled side tippers; for a total of nine rigid six-wheeled three-way tippers from seven separate customers; and for two four-wheeled "Garrett" steam wagons.

THE HACKBRIDGE ELECTRIC CONSTRUCTION COMPANY, Ltd., of Walton-on-Thames, has received what is claimed to be the largest industrial transformer order ever placed in this country. These transformers, comprising twenty-five units, will have an operating voltage of 154,000 volts and will, it is said, be the highest voltage power transformers so far manufactured in Great Britain. The transformers have been ordered by the Northern Aluminium Company, Ltd., of Bush House, London, and the value of the order is nearly £150,000. Tenders were invited from the leading Canadian and European manufacturers.

CALENDARS, DIARIES, &c.

JOSEPH ADAMSON AND CO., P.O. Box 4, Hyde, Cheshire.—Wall calendar with daily tear-off sheets.

AVONSIDE ENGINE COMPANY, Ltd., Bristol.—Wall calendar with monthly tear-off slips.

B.S.A. TOOLS, Ltd., Sparkbrook, Birmingham.—Wall calendar with monthly tear-off slips.

CAMBRIAN WAGON COMPANY, Ltd., East Moors-road, Cardiff. Wall calendar with monthly tear-off sheets.

FLOWERDEW AND CO., Ltd., 227–228, Strand, W.C. 2.—Desk calendar with monthly tear-off slips.

R. AND W. HAWTHORN, LESLIE AND CO., Ltd., Forth Bank Works, Newcastle-on-Tyne.—Wall calendar with monthly and daily tear-off slips.

BERNARD HOLLAND AND CO., 17, Victoria-street, S.W. 1.—Wall calendar with daily tear-off slips.

C. TOWNSEND HOOK AND CO., Ltd., 102–104, Queen Victoria-street, E.C. 4.—Wall calendar with monthly tear-off slips.

C. ISLER AND CO., Ltd., Bear-lane, Southwark, S.E. 1.—Wall calendar.

LANCASHIRE UNITED TRANSPORT AND POWER COMPANY, Ltd. Atherton, Lancs.—Wall calendar with monthly tear-off sheets.

The Institution of Civil Engineers.

OCTOBER EXAMINATIONS, 1929.—PASS LIST.

Preliminary (75).—F. S. A. Bather, G. Berry, J. P. Beveridge, C. Birtwell, E. Blacker, J. Blackwell, M. C. Brickell, S. R. Broderick, G. P. Bull, R. W. Bullmore, C. W. Carter, R. C. Cheyne, E. W. F. Clements, A. V. Currie, F. W. Curry, F. C. Dallimore, J. J. Davies, L. de Silva, R. Dewsberry, A. J. Egerton, N. P. Fielding, W. J. Frethey, P. W. Godfrey, E. G. Goldring, E. Gooseman, F. D. Grant, J. E. Guest, W. G. Haggie, F. J. Hegan, R. Herring, T. D. Heynes, J. Hodgson, C. P. Hosking, H. J. M. Hudson, W. Johnson, H. A. Leader, A. W. McLean, J. C. Maxwell-Cook, A. H. Maynard, P. J. Metcalf, V. G. Moloney, R. Mountstephens, V. A. Murphy, H. Nicholson, H. Noren, P. Nye, T. Pritchard, E. F. G. Ray, T. C. Richards, C. M. Roberts, J. W. L. Ruddy, J. L. Scott, R. D. K. Scott, T. D. Sellman, V. J. Sevian, J. L. Sharratt, T. M. Shivram, J. G. Smith, K. R. Stones, A. Sutherland, M. S. Sviridov, J. E. Taylor, J. J. Taylor, M. A. Thomas, R. M. Thomas, C. B. A. Turner, H. G. Walker, C. G. Wanhill, L. C. Waters, E. H. White, J. Whittaker, H. W. Willcock, R. T. Williams, G. D. Wyatt, J. Wyse.

ASSOCIATE MEMBERSHIP (277).

Whole Examination (Sections A, B and C) (13).—H. M. Alexander, R. I. Bataline, A. Boxall, J. J. P. Dolan, C. C. Dudley, L. C. E. Malt, A. G. Park, I. G. Robertson, R. A. Simpson, A. T. Slocombe, S. N. Srikantia, R. R. Torrie, E. A. Turner.

Sections A and B only (18).—W. T. I. Alagaratnam, J. Anderson, J. Arrol, R. S. Drake, I. A. Dubery, E. A. Gibson, R. F. Heaney, D. A. Lane, A. S. Lowe, C. J. W. Parsons, H. P. Pooley, A. M. Quennell, F. K. Roberts, N. P. Simansky, E. L. Snell, H. M. Watson, G. D. White-Parsons, W. E. Wright.

Sections A and C only (5).—H. G. W. Cook, J. L. Fraser, G. Shaw, G. G. Watson, D. M. Waite.

Sections B and C only (14).—J. A. Andrew, V. W. Beckley, K. R. Bhide, H. J. W. Buick, H. W. Cormack, A. F. Daldy, L. Essayed, T. L. Farnes, R. F. Lowe, I. Macallan, I. MacK. MacLean, F. R. E. O'Connor, N. O. Russell, G. Shrimpton.

Section A only (79).—W. B. Acton, R. A. H. Allen, A. A. Babbage, F. R. L. Barnwell, E. Bateson, J. E. Belbin, A. T. Black, W. Bowden, T. L. Bowring, D. L. Brown, G. W. Bruce, C. L. Burgess, A. Burrows, C. J. Carey, F. A. Carter, R. D. Chalcraft, A. J. Charman, J. T. Chester, G. F. Clifford, K. A. Cole, J. V. Cook, I. A. Cromie, C. S. Crump, M. N. Dalal, E. F. H. D'Ath, H. R. Davenport, I. L. D. Davies, J. H. Dossett, A. N. Duder, J. W. Dunn, T. G. Elliott, A. J. Felstead, S. A. Findlay, R. B. Francis, W. H. Gamble, A. T. Gandell, E. B. Gascoine, J. A. Goodsir, R. G. Griffin, T. H. Higson, C. Hodgson, E. A. O. Holst, E. Howard, R. A. Japp, W. G. King, D. H. Lawson, W. B. Lawson, R. A. Lyall, G. N. McCarthy, P. Macfarlane, R. L. McIlmoyle, C. McIntyre, G. H. McKenzie, J. R. Maden, R. Marshall, J. C. Martin, N. A. Matheson, H. Millican, T. W. S. Milligan, H. Morris, D. T. Owen, J. S. Robson, S. J. D. Russell, W. H. Sebley, J. D. Sheasby, C. J. S. Sims, F. W. Slade, F. Smith, H. S. Southern, C. H. S. Spaull, P. M. Spencer, T. H. Stayman, H. V. Steggles, A. N. Sutherland, C. K. Tallack, W. A. Usher, F. Waite, J. B. White, D. J. MacG. Williamson.

Section B only (26). J. Andrew, F. Bardsley, E. S. Benson, H. G. Buxton, L. V. Chhatre, F. H. Clark, H. L. Folkes, J. B. Footner, D. Garden, T. D. Hackney, M. O. S. Iyengar, G. A. Lewis-Bowen, L. A. Lincoln, C. R. Lovatt, W. B. Lyall, J. G. Pauling, D. J. Peacock, N. J. Pugh, G. W. Roberts, W. G. Sides, N. Singh, C. H. Smith, J. A. Stirling, E. Sykes, N. E. Westerhout, T. F. R. Wilson.

Section C only (122).—A. A. A. Abdeldayem, C. A. Adams, B.Sc. Eng. (Lond.), H. M. Alexander, jun., B.Sc. Eng. (Lond.) J. A. D. Anderson, F. V. Appleby, B.Sc. (Birmingham), H. R. Bach, I. A. Badawy, A. L. L. Baker, E. M. Barnes, B.Sc. Eng. (Lond.), N. Basu, B.Sc. (Edin.), H. W. Begbie, B.Sc. (St. Andrews), O. D. Bell, C. E. Bingham, H. R. E. Black, B.E. (New Zealand), G. C. Blofield, B.Sc. Eng. (Lond.), A. Borlase, H. C. Bowen, B.A. (Cantab.), R. P. Bradley, B.Sc. Eng. (Lond.), T. S. Brass, B.Sc. (Edin.), J. Brown, B.Sc. (Belfast), E. Burke, B.Sc. Eng. (Lond.), W. H. Burren, B. W. Charman, E. R. Cheesman, A. E. Clark, R. K. Clemow, B.E. (New Zealand), G. T. Cole, B.Sc. (Bristol), B. W. B. Cooper, B.E. (New Zealand), A. G. Copsey, H. G. Cousins, B.Sc. Eng. (Lond.), D. E. Coyle, B.Sc. Eng. (Lond.), W. R. D. Crarey, B.Sc. Eng. (Lond.), F. H. Creed, B.Sc. Eng. (Lond.), M. A. Davis, G. H. Deas, B.Sc. (Cape Town), E. W. F. F. Dohse, B.Sc. (Cape Town), W. C. Donnellan, B.E. (National), J. E. Dryden, B.E. (Sydney), H. M. Everett, J. H. B. Fairley, B.Sc. (Edin.), J. F. Firth-Hand, E. A. Fitzpatrick, B.Sc. Eng. (Lond.), C. W. Fraser, R. G. Gallien, F. R. Gaskell, J. K. Gerrand, B.Sc. (Cape Town), A. H. Gillard, D. M. Glendinning, B.Sc. (Glas.), W. Gribbin, B.Eng. (Liverpool), B. W. Hadfield, T. J. Henriques, B.Sc. Eng. (Lond.), J. A. Henry, B.Sc. (Belfast), E. J. Hill, B.Sc. (Birmingham), J. D. How, H. H. Hunt, A. P. P. Hutton, B.A. (Oxon.), H. S. Hvistendahl, B.Sc. Eng. (Lond.), A. Inglis, J. E. Jack, B.Sc. (Edin.), F. Jackson, B.Sc. (Edin.), R. H. James, W. G. Jamieson, B.Sc. (Glas.), J. R. Kanga, A. A. L. Lane, B.Sc. Eng. (Lond.), C. P. Lowe, D. G. MacCormack, B.Sc. (Glas.), J. W. Mearns, B.Sc. (Glas.), J. Meidlinger, B.Sc. (Witwatersrand), L. B. Mercer, B.C.E. (Melbourne), A. J. McD. Miller, J. L. Miller, B.Sc. Eng. (Lond.), W. G. Morrison, B.E. (New Zealand), E. A. Nadirshah, B.Sc. (Edin.), C. E. Nyman, B.Sc. (Cape Town), W. K. M. O'Hara, J. E. G. Palmer, B.A. (Cantab.), R. W. Palmer, B.Sc. (Bristol), E. O. W. L. V. Parisot, A. Parker, F. L. Pasley, J. B. R. Pedder, B.Eng. (Liverpool), E. R. Peet, B.A.I. (Dublin), R. T. Phillips, B.Sc. Eng. (Lond.), R. E. Pitt, B.Sc. Eng. (Lond.), A. N. Procter, B.Sc. Eng. (Lond.), F. A. Railton, B.Sc. (Wales), W. J. Rankin, R. H. Roberts, B.Sc. (Cape Town), E. M. Rowland, B.A. (Cantab.), J. R. Ryecroft, B.Sc. Eng. (Lond.), W. Schutz, B.Sc. (Cape Town), T. R. Sethna, S. E. Sherwood, B.Sc. (Birmingham), R. Simmers, B.Sc. (Glas.), E. R. Starling, B.Sc. (Witwatersrand), R. Stent, K. M. Steven, B.Sc. (Glas.), W. S. Stredwick, C. C. Strong, B.Sc. (Bristol), G. C. Stubbs, M. W. Summers, D. C. Summerton, B.Sc. (Birmingham), E. E. Sweeting, N. H. Taylor, B.Sc. Eng. (Lond.), J. Telfer, B.Sc. (Edin.), C. S. J. Tellis, B.Sc. (Glas.), M. J. Thomas, S. P. Thompson, B.Sc. (Leeds), W. E. Thorowgood, A. E. C. Trimble, B.A.I. (Dublin), J. H. W. Turner, B.Sc. (Glas.), R. J. C. Tweed, B.A. (Cantab.), D. M. Walker, B.Eng. (Sheffield), F. C. Walls, R. MacL. Watson, B.Sc. Eng. (Lond.), T. W. Weldhen, B.Sc. Eng. (Lond.), A. O. Whitehouse, B.Sc. Eng. (Lond.), M. T. B. Whitson, B.Sc. (Edin.), R. A. Wingfield Digby, B.A. (Cantab.), G. A. Wood, B.Eng. (Sheffield), F. R. Wright, L. de Zinovieff.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

SIR RICHARD TETLEY GLAZEBROOK, K.C.B., D.Sc., F.R.S., has been elected an honorary member of the Institution of Electrical Engineers.

MR. G. G. L. PREECE, A.M.I.E.E., until recently manager in the Manchester district for Bruce Peebles and Co., Ltd., of Edinburgh, has now been appointed to the position of sales manager for England and Wales.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	19/6 to 22/–
(1) Spanish	23/– to 24/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	23/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 1 0	—
No. 1 Foundry	4 0 6	—
No. 3 Foundry	3 18 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 19 0	3 19 0
No. 1	3 19 6	3 19 6
Cleveland—		
No. 1	3 15 0	3 15 0
Silicious Iron	3 15 0	3 15 0
No. 3 G.M.B.	3 12 6	3 12 6
No. 4 Foundry	3 11 6	3 11 6
No. 4 Forge	3 11 0	3 11 0
Mottled	3 10 6	3 10 6
White	3 10 6	3 10 6
MIDLANDS—		
(3) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 15 6	—
„ „ Foundry	3 19 6	—
(3) Northampton—		
Foundry No. 3	3 15 0	—
Forge	3 11 0	—
(1) Derbyshire—		
No. 3 Foundry	3 18 6	—
Forge	3 14 6	—
(3) Lincolnshire—		
No. 3 Foundry	3 13 6	—
No. 4 Forge	3 9 6	—
Basic	—	—
(4) N.W. COAST— N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 9 6 (*a*); 4 11 6 (*b*); 4 15 0 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 10 0	—
Common Bars	10 15 0	—
Best Bars	11 5 0	—
Double Best Bars	11 15 0	—
Treble Best Bars	12 5 0	—
LANCS.—		
Crown Bars	10 15 0	—
Second Quality Bars	9 15 0	—
Hoops	13 0 0	—
S. YORKS.—		
Crown Bars	11 0 0	—
Best Bars	11 10 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	10 0 0 to 10 7 6	—
Marked Bars (Staffs.)	12 10 0	—
Nut and Bolt Bars	9 2 6 to 9 5 0	—
Gas Tube Strip	11 2 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 0 0	10 0 0
Ship Plates, ¾in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	9 0 0	8 15 0
Sheets (Gal. Cor. 24 B.G.)	13 0 0	12 15 0

STEEL (*continued*).

	Home. £ s. d. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 10 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	—
Billets	6 15 0 to 9 10 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	8 5 0 to 8 7 6	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	10 0 0	—
SHEFFIELD—		
Siemens Acid Billets	9 10 0 (basis)	—
Hard Basic	9 2 6 and 9 12 6	—
Intermediate Basic	7 12 6 and 8 2 6	—
Soft Basic	6 15 0	—
Hoops	9 15 0 to 10 5 0	—
Soft Wire Rods	8 0 0	—
MIDLANDS—		
Small Rolled Bars	8 2 6 to 8 15 0	—
Billets and Sheet Bars	6 2 6 to 6 12 6	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	12 5 0 to 12 15 0	—
Angles	8 7 6	—
Joists	8 10 0	—
Tees	9 7 6	—
Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 12 6	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/9 to 19/–
Block Tin (Cash)	174 7 6
„ (three months)	177 12 6
Copper (cash)	71 17 6
„ (three months)	69 10 0
Spanish Lead (cash)	21 12 6
„ „ (three months)	21 12 6
Spelter (cash)	19 5 0
„ (three months)	19 17 6
MANCHESTER—	
Copper, Best Selected Ingots	78 5 0
„ Electrolytic	83 15 0
„ Strong Sheets	110 0 0
„ Tubes (Basis Price), lb.	0 1 3
Brass Tubes (Basis Price), lb.	0 1 1
„ Condenser, lb.	0 1 3
Lead, English	23 2 6
„ Foreign	21 12 6
Spelter	19 15 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

Tungsten Metal Powder	3/4½ per lb.	
Ferro Tungsten	3/1½ per lb.	
	Per Ton.	Per Unit.
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/6
„ „ 6 p.c. to 8 p.c.	£22 0 0	6/6
„ „ 8 p.c. to 10 p.c.	£21 17 6	6/–
„ „ Specially refined		
„ „ Max. 2 p.c. carbon	£33 0 0	10/–
„ „ „ 1 p.c. carbon	£39 0 0	15/–
„ „ „ 0·70 p.c. carbon	£41 0 0	15/–
„ „ „ carbon free	1/– per lb.	
Metallic Chromium	2/6 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home; £13 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£11 10 0 scale 5/– per unit	
„ „ 75 p.c.	£19 0 0 scale 7/– per unit	
„ Vanadium	12/10 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	1/– per lb.	
Nickel (per ton)	£170 to £175	
Ferro Cobalt	9/6 per lb.	

FUELS.

SCOTLAND.
(*Prices not stable.*)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	14/6 to 15/–
„ „ Ell	16/–
„ „ Splint	16/6 to 17/6
„ „ Trebles	16/6
„ „ Doubles	15/6
„ „ Singles	14/6
AYRSHIRE—	
(f.o.b. Porta)—Steam	14/6
„ „ Jewel	17/6
„ „ Trebles	16/6
FIFESHIRE—	
f.o.b. Methil or Burntisland—Steam	14/– to 16/6
Screened Navigation	18/– to 19/6
Trebles	17/– to 17/6
Doubles	15/6
Singles	14/6 to 15/–
LOTHIANS—	
(f.o.b. Leith)—Best Steam	14/6
Secondary Steam	14/3
Trebles	17/–
Doubles	15/6
Singles	14/6

ENGLAND.

(8) N.W. COAST—	
Steams	21/6 to 23/–
Household	38/– to 51/–
Coke	26/6
NORTHUMBERLAND—	
Best Steams	17/–
Second Steams	16/–
Steam Smalls	11/– to 11/6
Unscreened	13/– to 13/6
Household	25/– to 37/–
DURHAM—	
Best Gas	16/9 to 17/–
Second	15/6 to 15/9
Household	25/– to 37/–
Foundry Coke	25/– to 30/–
SHEFFIELD—	Inland.
Best Hand-picked Branch	26/6 to 28/–
Derbyshire Best Bright House	21/– to 23/–
Best House Coal	20/6 to 21/6
Screened House Coal	18/6 to 20/–
„ „ Nuts	16/6 to 18/–
Yorkshire Hards	15/6 to 17/–
Derbyshire Hards	15/6 to 17/–
Rough Slacks	9/– to 10/–
Nutty Slacks	7/6 to 8/6
Smalls	3/– to 5/–
Blast-furnace Coke (Inland)	17/– on rail at ovens
Furnace and Foundry Coke (Export), f.o.b.	24/– to 24/6

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	20/– to 20/3
Second Smokeless Large	18/9 to 20/–
Best Dry Large	20/– to 20/6
Ordinary Dry Large	19/– to 20/–
Best Black Vein Large	18/6 to 18/9
Western Valley Large	18/6 to 18/9
Best Eastern Valley Large	18/3 to 18/6
Ordinary Eastern Valley Large	17/9 to 18/–
Best Steam Smalls	14/3 to 14/9
Ordinary Smalls	13/– to 14/–
Washed Nuts	19/6 to 30/–
No. 3 Rhondda Large	21/– to 21/6
„ „ Smalls	15/6 to 16/–
No. 2 „ Large	17/3 to 17/6
„ „ Through	15/6 to 16/6
„ „ Smalls	14/6 to 15/–
Foundry Coke (Export)	32/6 to 37/–
Furnace Coke (Export)	29/– to 30/–
Patent Fuel	22/– to 22/6
Pitwood (ex ship)	27/6 to 27/9
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	36/– to 38/–
Seconds	30/– to 32/6
Red Vein	26/– to 28/–
Machine-made Cobbles	43/6 to 45/6
Nuts	45/– to 47/6
Beans	27/– to 29/–
Peas	20/– to 20/6
Breaker Duff	10/9 to 11/3
Rubbly Culm	12/9 to 13/6
Steam Coals:	
Large	20/6 to 21/6
Seconds	18/6 to 19/6
Smalls	13/6 to 14/6
Cargo Through	15/6 to 16/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 12/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 10/– if home consumers confine purchases from associated British Steel Makers.

French Engineering Notes.

(From our Correspondent in Paris.)

Public Transports.

An increase in the fares of all the public transport services in Paris is revealing the drawbacks of the existing organisation which can hardly do otherwise than produce deficits that have to be made good by users. All the public services are conceded by the municipality to companies which are bound by strict obligations. A percentage of the receipts goes to the municipality, and, in some cases, the dividends paid to shareholders are limited to a maximum of 10 per cent. At the same time, the municipality practically controls all the services and nothing can be done without its sanction, the result being that influences are usually at work on behalf of particular interests. As the municipal finances show a heavy deficit, the public services have been laid under contribution, and even the taxicabs have not escaped, for while an augmentation of the tax on cab ranks is intended to compensate partly for the suppression of the *octroi* duty on petrol its object is, avowedly, to compel cab owners to raise their fares and so lessen competition with other public vehicles. On one day last week, all the cabs were withdrawn from the Paris streets as a protest against the higher taxes. In the same way, the price of gas has been raised, and the proposal to increase the cost of electricity was only withdrawn as the result of public protest. The danger of a municipality controlling public services has become obvious to everyone. On the railways, also, the situation has once more become precarious. The deficit during 1929 is stated to have been something like 150 million francs, and the present year offers little prospect of improvement in view of diminishing trade and the probability of a further advance in railwaymen's wages. It was proposed to make the deficit good by increasing the railway rates, but they have been advanced so considerably of late years that the Public Works Department has rejected the demand. Industrial users argue that the only remedy lies in the State reducing or even suppressing the heavy tax on transport, for which it is difficult to see any justification.

Import Duties.

On the eve of the proposed "tariff holiday," the French Government has introduced a Bill modifying some of the existing duties. While the Government has officially approved of the principle of an international agreement to make no advance in tariffs during a stated preiod, manufacturers object to an arrangement which will tie their hands in the event of its being necessary to protect themselves still further from foreign competition. So long as the franc was depreciated that alone provided ample protection, but, since the monetary stabilisation, prices have been advancing to a gold level. Makers fear that the rising wages and higher charges following upon the application of the social insurance scheme will let in foreign goods unless something is done now to prevent it. The new Bill accomplishes this to a certain extent by replacing the *ad valorem* duties with specific duties—that is to say, by weight. The *ad valorem* duties have always been objected to by the Customs, which experience great difficulty in verifying the declarations of importers, and goods are sometimes held up for considerable periods until the disputes are settled by expert valuations. While the changes to be effected in the tariffs will certainly be in the direction of strengthening the duties at present levied by values, there are indications that something will be done to give satisfaction to industries that are complaining of insufficient protection. The progress of the new Bill should be carefully watched, because it will be difficult for the Government to resist the claims of manufacturers for increased duties.

Loss of Cruiser.

The "Edgar-Quinet" has been wrecked under conditions very similar to those which caused the loss of the "France" several years ago, when that battleship struck an uncharted rock near the coast and foundered. The "Edgar-Quinet" was a 14,000-ton cruiser, built in 1907, and she was entirely reconditioned to serve as a training ship when the "Jeanne d'Arc," previously used for that purpose, was withdrawn. Her main armament still consisted of fourteen 194 mm. guns, but with the removal of boilers to provide more accommodation for the cadets the speed was reduced to 15 knots. As a fighting unit she had no value. The cruiser was manœuvring off Oran when she struck a rock which held her fast by the middle, the fore and aft overhanging in about 30 m. of water. The rock is uncharted, although it is stated to be well known to fishermen along the coast. The hull was pierced, but it was hoped at first that it would be possible to patch up the hole—15 m. long—and float the vessel off, but the weather became bad and the ship broke in two, the aft portion sinking below the surface.

Electrically Propelled Liner.

The Cie Générale Transatlantique has taken delivery from the Vulkan shipyard of a liner to be known as the "Washington" which Germany has supplied on account of reparations. Having a length of 149 m. and a width of 18·59 m., the new vessel has a displacement of 16,800 tons. Its two propellers are driven electrically by 6000 H.P. motors. The ship will be put on the North Pacific service for both cargo and passengers. The fact that the Cie Générale Transatlantique should have procured this ship in Germany and should have ordered six others from Belfast for delivery at the end of this year, all of them for the North Pacific service, at a time when the French shipyards are short of work, is arousing a good deal of protest, and an attempt is being made to organise an agitation to prevent the subsidised steamship companies from ordering vessels abroad. The Minister of Merchant Marine recently stated that French shipowners must be provided with the means of purchasing vessels as cheaply as the foreign shipping companies, and they can obviously only do that by going to the cheapest market.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

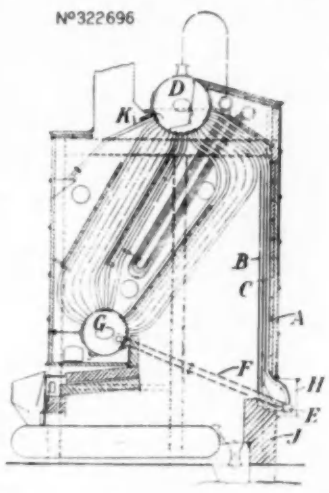
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

322,696. February 14th, 1929.—WATER-TUBE STEAM BOILERS, The Stirling Boiler Company, Ltd., of 32 and 33, Farringdon-street, London, E.C. 4; and Ernest Edward Noble, of 30, Ashleigh-grove, Fulwell, Sunderland.

The wall A of the combustion chamber opposite the fuel supply side has a water-cooled screen constituted by rows of vertical or semi-vertical tubes B and C connected at their upper ends with the upper drum D and at their lower ends with a drum, or header E, which in turn is connected by external circulating

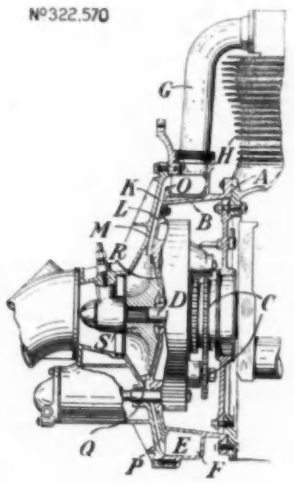


tubes F with the mud drum G. The header E is arranged in a pocket formed by the casing H of the boiler and the bridge wall J of the furnace, and serves to screen the junctions of the tubes B and C with the header E. The screen formed by the tubes B and C is heated mainly by the radiant heat of the furnace. The invention is applicable also to tri-drum boilers. K denotes the tubes of a feed water system adapted to supply feed water to the steam drum D to be used in lieu of the usual feed.—*December 12th*, 1929.

INTERNAL COMBUSTION ENGINES.

322,570. October 1st, 1928.—SUPERCHARGERS FOR INTERNAL COMBUSTION ENGINES, Armstrong-Siddeley Motors, Ltd., Frederick Robertson Smith, and Spirito Mario Viale, all of Armstrong-Siddeley Works, Park Side, Coventry.

This invention relates to superchargers for internal combustion engines, of the kind comprising a rotor which delivers into an annular pipe communicating with the cylinders by branches to the inlet valves. The object of the invention is to increase the efficiency and incidentally to reduce the heating of the charge. A relatively small central rotor chamber containing a bladed rotor delivers into a narrow annular bladeless vortex chamber of considerable radial width and communicating at its periphery with the annular pipe. Preferably, the latter is to one side of the

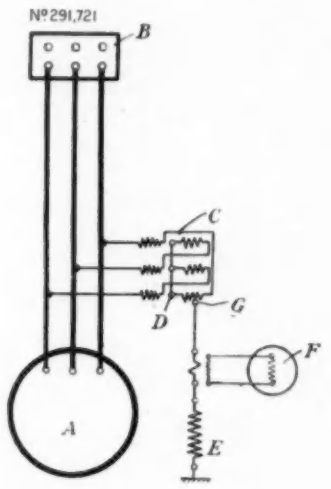


rotor chamber and the vortex chamber communicates with one edge of the annular pipe. Thus the annular pipe can be close to the engine, leaving a deep recess for containing the gearing driving the rotor. To the face A of the engine is bolted a conical casing B, which encloses the gearing C driving the rotor shaft D which passes through the centre of the casing. The periphery E of the casing preferably forms the inner wall of the annular pipe F from which branches G lead to the cylinders H. This annular pipe is preferably of a flattened oval cross section, and the end remote from the engine communicates with a vortex chamber K, the walls L and M of which are preferably straight and parallel and inclined to the axis of the rotor as shown. With such an arrangement the flow from the rotor chamber to the annular pipe is assisted, and consequently, as the latter is of constant cross section, having a number of branches arranged around its circumference, the distribution to the various cylinders is further improved. Alternatively, the walls L and M may be curved and converge or diverge in either direction. In order to vary the cross section of the annular pipe F to suit different types of engines, rings of varying shapes, such as those shown at O and P, may be bolted to the wall L. At their inner ends the walls diverge at Q and communicate with the rotor chamber R which contains a shrouded rotor S mounted upon the shaft D.—*December 12th*, 1929.

SWITCHGEAR.

291,721. June 5th, 1928.—EARTH FAULT ELECTRIC PROTECTIVE ARRANGEMENTS FOR ALTERNATING-CURRENT GENERATORS, *International General Electric Company, Incorporated, of* 120, *Broadway, New York, United States of America.*

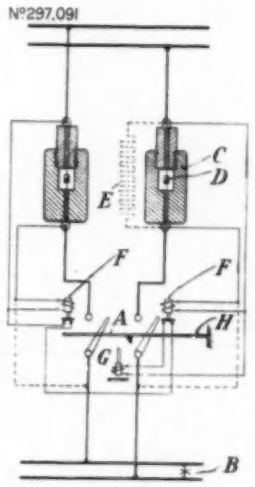
The object of this invention is to provide a protective arrangement suitable for generators or transformers which enables protection to be afforded against earth faults to all points of the generator or transformer winding irrespective of the connections. A protective arrangement is illustrated for a generator A, the internal connections of which may be of any desired nature, connected to a supply system through a transformer B. In order to provide a point with a potential which does not correspond with that of any point on the generator, an auxiliary choke coil C is connected to the terminals of the generator, and the connections of this must be different from those of the generator. In the drawing it is assumed that the generator or the primary side of the transformer is connected in delta or star,



while the choke coil C is shown as having a zigzag circuit, and is provided with a neutral point D. A point on the choke is earthed through an impedance E, and with this earthing connection is inductively associated a protective relay F arranged to disconnect the generator A or transformer B from the supply line. The earthing connection to the choke is made to a point G which has a potential which does not correspond with that of any point on the generator or transformer. For instance, if the generator is connected in star, the only points on the zigzag choke which correspond in potential to points on the generator are the neutral point and the outer ends of the choke which are connected to the terminals of the generator. It will be thus seen that any other point on the choke, such as the point G, has a potential which does not correspond in potential with any point on the generator. In the event of an earth leakage occurring in any part of the generator or transformer there always exists a potential to earth sufficient to operate the relay F.—*December 5th*, 1929.

297,091. September 14th, 1928.—OVERLOAD PROTECTIVE ARRANGEMENTS, *International General Electric Company, Incorporated, of* 120, *Broadway, New York, United States of America.*

The essential feature of this invention consists in the fact that the circuit breaker is not directly released by the overload, but that the release is effected by a no-voltage release device which comes into operation when the overload protective device has functioned. The no-voltage release device is also arranged to become effective on a decrease of voltage without an over-



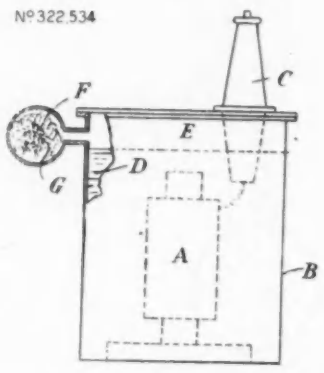
current. With over-current, however, the release device can only operate independently of the value of the over-current, when the protective device has operated. A is the circuit breaker which connects the small consumer B with the main supply. In the connecting feeder is a device C consisting of a resistance material, which is normally shunted by an overload protective device D, as, for instance, a fuse. The resistance E indicated in dotted lines serves solely as a symbol for the resistance properties of the device C, which may have a resistance of any desired kind. Connected in shunt to the resistance C is the

operating coil of the relay F which controls the excitation circuit of the no-voltage release device G. H is a spring which biasses the switch A into its "open" position as soon as the no-voltage release device becomes effective. The operation of the device is as follows:—As soon as a short circuit or overload occurs in B the overload protective device D acts in the first place so that the short circuit current is reduced to any desired value depending on the resistance C, which has now become effective. Owing to the passage of the current through the resistance, a voltage drop occurs, which suffices to cause the relay F to be energised. The circuit of the no-voltage release G is consequently interrupted and the tripping mechanism of the switch A is operated, thus finally removing the short circuit at a reduced short circuit current. Alternatively, the relay F can be connected in the manner indicated by the dotted lines. In this case the relay F remains energised as long as the short circuit exists in the consumers' circuit B even with the switch A open. Consequently, if it is attempted to close the switch A, it will immediately be again released. With the connection shown in full lines, however, the switch A would remain closed until a flow of current sufficient to cause a voltage drop across resistance C necessary to energise relay F had taken place.—*December 12th*, 1929.

TRANSFORMERS AND CONVERTERS.

322,534. September 8th, 1928.—OIL TANKS FOR OIL-IMMERSED ELECTRICAL APPARATUS, SUCH AS TRANSFORMERS, John Bentley Hansell, of 121, Eccles Old-road, Pendleton, Manchester; and Metropolitan-Vickers Electrical Company, Ltd., of 4, Central-buildings, in the City of Westminster.

According to this inventiou, in or associated with the oil tank of a transformer there is a closed expansion space or chamber which contains a gas or vapour and a material which is capable of accommodating comparatively large changes of volumes of the gas or vapour for relatively small changes of pressure. The transformer is shown at A and is arranged within a closed tank B, the usual terminal structure being indicated at

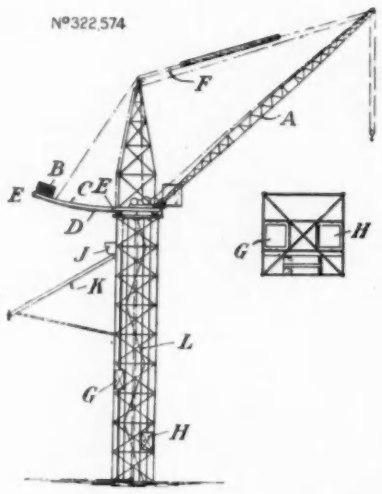


C. The transformer is immersed in a body of oil D which does not completely fill the transformer tank, a space E being left above the free surface. This space is occupied by a gas, preferably an inert gas, such as carbon dioxide or nitrogen. Opening out of the space E is a spherical or cylindrical container F, which is filled with an absorbent material, preferably charcoal or coke. An increase of temperature of the transformer causes a rise in the pressure of the gas in the space E. The charcoal or coke G, however, immediately absorbs some of the gas and reduces the pressure so that harmful pressure effects on the tank are avoided, while at the same time there is no deleterious communication between the external atmosphere and the transformer oil.—*December 9th*, 1929.

CRANES AND CONVEYORS.

322,574. October 1st, 1928.—TOWER CRANES, Caswell Cranes and Erection, Ltd., and George Frederick Charles Caswell, both of 53, Victoria-street, London, S.W. 1.

In accordance with this invention the weight of the jib A is balanced by means of a counterweight B supported on a platform C and connected with the jib by a wire D passing around pulleys E at the outer and inner ends of the platform C and at the top of the crane tower in such manner that as the jib is raised or lowered by means

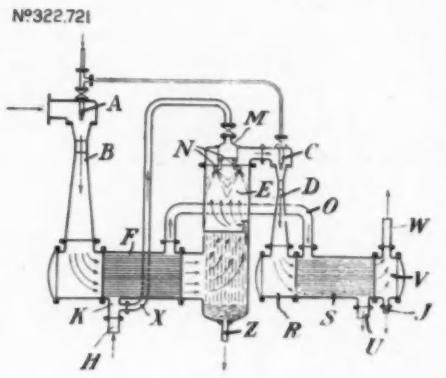


of the jib wire F the counterweight B is moved towards or from the mast of the crane. The platform C for the counterweight is preferably inclined towards the mast, so that the counterweight will move towards the mast by gravity. As shown, the tower itself and the mast are formed of skeleton framework, and in accordance with another feature of the invention the framework of the tower is arranged as indicated in plan for the interposition of a concrete hoist G and a barrow hoist H at opposite sides. In association with the concrete hoist there is a hopper J serving to feed the concrete delivered by the hoist to a chute K which is adapted to be swivelled in a suitable manner. The chute may be associated with other chutes by means of which the concrete may be conveyed anywhere on the sides. The staircase indicated by L is preferably embodied in the tower structure.—*December 12th*, 1929.

MISCELLANEOUS.

322,721. May 16th, 1929.—MULTI-STAGE STEAM JET EJECTORS, G. and J. Weir, Ltd., of Holm Foundry, Catheart, Glasgow, and James Sim, of the same address.

This invention relates to multi-stage steam-jet ejectors, for example, to the ejectors used to discharge the air from the main condensers in steam power plants. The object of the invention is to reduce the heat loss while retaining the air-handling advantage. A is the steam jet nozzle and B the combining nozzle and diffuser of the first stage. C is the steam nozzle and D the combining nozzle and diffuser of the second stage. The discharge from the first stage is passed through the surface condenser F. The steam and uncondensed vapour therefrom pass into the chamber E of the direct-contact condenser. This chamber is of considerable height with respect to its lateral dimensions. H is a water pipe bringing condensate from the main condenser. This pipe is branched. The branch K takes the water to the surface condenser F, where it is employed as the cooling or condensing water, while the other branch X



leads the water to the water receiving and delivery chamber M of the direct-contact condenser. The water is discharged into the main chamber of the direct-contact condenser through the nozzles N. The second stage ejector draws the air from the top end of the chamber E and discharges it into the end chamber R of the surface condenser S. The cooling or condensing water for the condenser S is the same water as has been employed for the same purpose in the condenser F, the water being conducted from the one condenser to the other by way of the pipe O. This cooling water, on discharge from the condenser S by the pipe U, is delivered into the feed system. The condensate collecting in the bottom of the chamber E is arranged to flow back through the pipe Z and either through a trap or through a loop or U pipe to the main condenser. As regards the condensate deposited in the delivery chamber V of the condenser S, this may be discharged, by way of the pipe J, to the feed tank, or it may be passed back through a trap to the main condenser. The air delivered into the chamber V is discharged through the pipe W to the atmosphere.—*December 12th*, 1929.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, S.W. 1. Informal meeting. "The Pooling of Experience—a Function of the Institution?" to be introduced by Mr. Thomas Walley. 7 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Meeting of the South Midland District at Watford. Meet at Watford Junction Station, 11.15 a.m.; proceed to Imperial Works, Balmoral-road, Watford (Penfold Fencing, Ltd.); business meeting of the South Midland District at the works, 12.45 p.m.; lunch at the "Rose and Crown," Watford Market Place; tour of inspection of Messrs. Scammell's Motor Engineering Works, Watford West. 2.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Informal meeting. "London's Water Supply," by Mr. G. Andrew-Marshall. 7.30 p.m.

MONDAY, JANUARY 20TH.

BRADFORD ENGINEERING SOCIETY.—In the Hall of the Bradford Technical College, "The Atritor System of Pulverised Fuel Firing," by Mr. J. Burns, followed by a cinematograph film entitled "A British Key Industry." 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, Westminster, London, S.W. 1. London Graduates' Section. "Modern Methods of Speeding-up Railway Traffic," by Mr. O. S. Nock. 7 p.m.

TUESDAY, JANUARY 21ST.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Broadgate Café, Coventry. Graduates' meeting. "Preparation of an Engine for Production," by Mr. L. Hathaway. 7.15 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—198, West-street, Sheffield. "Temperature Distribution and Stress Effects in Heating and Cooling of Masses," by Mr. G. Stanfield. 7.30 p.m.

WEDNESDAY, JANUARY 22ND.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "Observations on the Mining Laws of the British Empire," by Mr. Gilbert Stone. 8 p.m.

THURSDAY, JANUARY 23RD.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—In the Chamber of Commerce, New-street, Birmingham. "Dock Maintenance from a Junior Engineer's Standpoint," by Mr. L. Cleaver. 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—In the Lecture Theatre, Savoy-place, Victoria Embankment, W.C. 2. "The Breaking Performance of High-power Switchgear and of a New Form of Quenched Arc Switch," by Mr. L. C. Grant. 6 p.m.

ROYAL AERONAUTICAL SOCIETY.—In the Lecture Hall of the Royal Society of Arts, 18, John-street, Adelphi, W.C. 2. "Certificates of Airworthiness," by Mr. H. B. Howard. 6.30 p.m.

FRIDAY, JANUARY 24TH.

INSTITUTION OF CHEMICAL ENGINEERS.—In the Lecture Theatre of the Institution of Civil Engineers, Great George-street, Westminster, London, S.W. 1. "Films and Fibres Derived from Cellulose," by Dr. Herbert Levinstein. 6.30 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS (LONDON): MANCHESTER CENTRE.—In the Building of the Manchester Literary and Philosophical Society, 36, George-street, Manchester. Presidential address by Mr. J. R. Baxin. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, Westminster, London, S.W. 1. "General Operating Experiences with the First 'Wood' Steam Generator," by Mr. E. Watson Smyth. 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "Refractories for Steam-raising Furnaces," by Mr. W. J. Rees. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Bolbec Hall, Newcastle-upon-Tyne. "Failure of Steel Forgings and Castings through Fatigue," by Mr. Robert A. MacGregor. 6 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, London, W. 1. Discourse, "Cellulose in the Light of X-rays," by Sir Wm. Bragg, F.R.S. 9 p.m.

SATURDAY, JANUARY 25TH.

INSTITUTE OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH, JUNIOR SECTION.—In the College of Technology, Sackville-street, Manchester. "Foundry Costing," by Mr. J. O. Gray. 7 p.m.

MONDAY, JANUARY 27TH.

NORTHAMPTON ENGINEERING COLLEGE ENGINEERING SOCIETY.—St. John-street, E.C. 1. "Realism from Records," by Mr. G. A. V. Sowter. There will also be a demonstration with apparatus kindly lent by Dr. N. W. McLachlan. 5.30 p.m.

TUESDAY, JANUARY 28TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Graduates' visit to the works of Morris Motors, Ltd. (Engines Branch), Gosford-street, Coventry. 8 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Watergate House, Adelphi, W.C. 2. London Graduates' informal meeting. "Discussion," "Tuning Motor Cycles for Speed," by Mr. S. C. Vince. 7.25 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Paper to be submitted for discussion, "Stable Channels in Alluvium," by Mr. Gerald Lacey. 6 p.m.

SHEFFIELD METALLURGICAL ASSOCIATION.—198, West-street, Sheffield. "Density of Molten Steel," by Mr. B. S. Smith. 7.30 p.m.

WEDNESDAY, JANUARY 29TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—At the Works of the Austin Motor Company, Ltd., Northfield. Graduates' meeting. "The Value of the Institution to its Junior Members," by Professor W. Morgan. A discussion will follow. 7.30 p.m.

SATURDAY, FEBRUARY 1ST.

STAFFORDSHIRE IRON AND STEEL INSTITUTE.—Annual dinner at the Dudley Arms Hotel, Dudley. 6 p.m.

WEDNESDAY, FEBRUARY 5TH.

INSTITUTION OF CIVIL ENGINEERS: MANCHESTER AND DISTRICT ASSOCIATION.—At the Midland Hotel, Manchester. Annual dinner. 6.30 p.m.

FRIDAY, FEBRUARY 14TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, Westminster, London, S.W. 1. Informal meeting. Lantern lecture, by Mr. G. Stevenson Taylor, followed by a visit to the Home Office Industrial Museum. 7 p.m.

MONDAY TO FRIDAY, FEBRUARY 17TH TO 28TH.

BRITISH INDUSTRIES FAIR.—Olympia and Castle Bromwich, Birmingham.

ERRATUM.—By a clerical error in the paragraph dealing with Birmingham in our Annual Article on "Water Supply in 1929," which appeared on page 39 of our issue of January 10th, the further length of the third main of the Elan Valley Aqueduct now under construction was given as being 50 miles. The figure should have read 5½ miles.

"EXHIBITIONS AND SHOWS."—We have received the January issue of a kind of broad-sheet which gives particulars of British and Overseas Exhibitions, Agricultural, Livestock and Horticultural Shows arranged to take place in 1930. They reach the appalling number of 1150! The paper is to be published monthly at 149, Fleet-street, and will be forwarded on application at the cost of 2s. post free.

UNIVERSITY COLLEGE, LONDON: ENGINEERING ENTRANCE SCHOLARSHIP.—The University College Committee has recently increased the annual value of the Goldsmid Engineering Entrance Scholarship from £40 to £50. The scholarship is tenable, subject to satisfactory progress, for the three years required for a full course of study for the Engineering Degree or Diploma, both of which may be taken concurrently. The next award will be made on the results of an examination for which candidates are required to enter not later than March 12th, 1930. The Secretary of the College will be glad to supply fuller particulars.

THE INSTITUTE OF INDUSTRIAL ADMINISTRATION.—The Institute of Industrial Administration, of 47/51, King William-street, seeks to raise management to the status of an organised profession. It was formed some years ago by Mr. E. T. Elbourne, and has recently been re-organised. It is enrolling employers, managers already qualified by experience, and young people who desire to qualify themselves by study, in the common aim of raising the standard of management of British industry, and has now completed the working out of a complete system of study for those who seek to fit themselves for positions of responsibility. A Board of Examiners has been formed with Principal H. Schofield at its head. A definite course of instruction has been laid down and examinations are to be held in the surprisingly wide range of knowledge which is, or should be, common to management in all industries.